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OF
AGRICULTURAL RESEARCH, PUSA.

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OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.

1906, Vol. I. (January to April).

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January 16, 1906.

Howard Saunders, Esq., Vice-President,
in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in December 1905:—

The registered additions to the Society's Menagerie during the month of December were 203 in number. Of these 26 were acquired by presentation and 25 by purchase, 108 were received on deposit, 42 by exchange, and 2 were born in the Gardens. The total number of departures during the same period, by death and removals, was 182.

Amongst the additions special attention may be directed to:—

An Agile Gibbon (*Hylobates agilis*), from Sumatra, deposited on Dec. 16th.

A Cross's Guenon (*Cercopithecus crossi*), from the Cameroons, deposited on Dec. 29th. New to the Collection.

A Grysbok (*Nototragus melanotis*), from South Africa, deposited on Dec. 18th.

A Snowy Owl (*Nyctea scandiaca*), from Arctic Europe, purchased on Dec. 16th.

A Madagascar Tree-Boa (*Corallus madagascariensis*), deposited on Dec. 19th.

The Secretary also exhibited a series of photographs of the Red

Deer illustrating the growth of the antlers, which had been presented to the Society by Mr. Walter Winans, F.Z.S.

Prof. E. A. Minchin, F.Z.S., exhibited a living specimen of a Lemur (*Galago*) which he had brought home with him from Entebbe, Uganda.

Dr. F. G. D. Drewitt, F.Z.S., exhibited, and made remarks upon, a white variety of the Common Mole.

Mr. Oldfield Thomas, F.R.S., exhibited the skull of a female Forest-Pig (*Hylochœrus*), which had been received from Mr. G. L. Bates, who had obtained it from natives of the Ja River, Cameroons, thus confirming the reports already published[*] as to the occurrence of *Hylochœrus* on the west side of Africa. It was to be noticed, however, that the Ja River was not on the West Coast watershed, but rose some 150 miles inland and flowed eastwards to join the general Congo system by way of the Nyoko and Sanga tributaries; so that this place was the furthest westward point of the true Congo basin, slightly further west in lat. 3° N. than even the main mouth in 6° S. It was therefore quite likely to be the western limit of the genus *Hylochœrus*.

On comparing the skull of the Ja pig with those from Central and East Africa already in the Museum, now numbering five of different ages and sexes[†], Mr. Thomas had come to the conclusion that it could not be assigned to the same species, on account of its much smaller teeth, and therefore proposed to call it *Hylochœrus rimator*[‡] (Thomas, Abstr. P. Z. S. No. 25, p. 1, Jan. 23, 1906). For while the general shape of the skull appeared to be similar, the teeth throughout were very markedly narrower, the difference being especially noticeable in the large posterior tooth, m^3 (text-fig. 1, *a*). This tooth was not only narrower at its broadest, anterior, point, but tapered posteriorly much more strongly and ended in a point, while in the Eastern form the tooth was broad, tapered but slightly, and had a broadly rounded end. Throughout, the enamel of the teeth appeared to be much less heavily coated with cement, so that they had a markedly lighter and more delicate appearance. In the lower jaw the same characters were observable, m_3 (text-fig. 1, *b*) being especially long and narrow, its length more than three times its greatest breadth, while in the allied forms the length was barely $2\frac{1}{2}$ times the breadth.

There was also a certain difference in the detailed structure of the teeth, as might be seen by a comparison of the figures (text-fig. 1) now given with those formerly published.

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[*] P. Z. S. 1904, ii. p. 196.

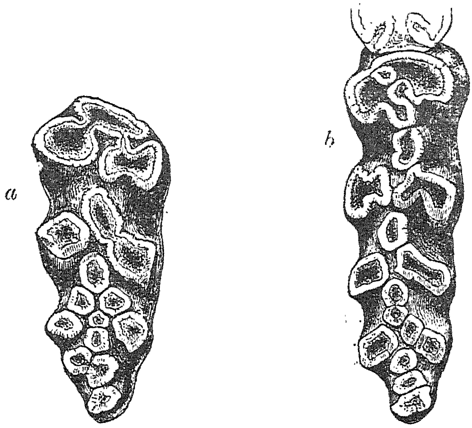
[†] The Museum was indebted to Mr. C. W. Haywood for one young skull and two skeletons, and to Col. Harrison for a fine pair of adult skulls.

[‡] [The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—EDITOR.]

The skull itself was comparatively light and delicate, with a low muzzle and slender zygomata. Its dimensions were as follows:—

Basal length (approximate) 325 mm.; zygomatic breadth 176; nasals, length 191, breadth 42; interorbital breadth 88; height of muzzle in front of premolars 57; least breadth of maxillary zygomatic processes, below orbit, 42; least vertical breadth of zygomata, behind true orbit, 36; palatal length 232; breadth across sockets of canines 98; breadth between tips of canines 181; greatest diameter of canines 24; length of upper tooth-row, from front of p^3 97; m^3, length 42·3, breadth 17·5; length of lower tooth-row, from front of p_4, 99; m_3 48·2 × 16.

Text-fig. 1.



a, upper, and *b*, lower right molars of *Hylochœrus rimator*.

Type. Old female skull. B.M. No. 6.2.21.1. Collected by Mr. G. L. Bates.

Native name "Engak" (G. L. Bates).

The remarkable character of the suppression of p^4 and persistence of mp^4, described in the typical specimens of *H. meinertzhageni*, was present in this specimen, as in other examples of the genus since received, and was evidently normal.

Another interesting point to be noticed was that the prenasal bone in all fully adult specimens of *Hylochœrus* was firmly united to an ossified mesethmoid.

The following papers were read:—

1. On Mammals from South Johore and Singapore collected by Mr. C. B. Kloss. By J. Lewis Bonhote, M.A., F.L.S., F.Z.S.

[Received December 7, 1905.]

(Plate I.*)

The following is an account of a small collection of mammals collected by Mr. C. B. Kloss in the southern part of Johore and the island of Singapore. From the latter place, which has been for long the emporium of that portion of the East, and from which many new species have been described, genuine wild collected ecimens are most welcome, and up to the present but few ecimens have been received from Johore. During the last few years several collections from the Malay Region have been received in both London and Washington, so that the number of novelties in the present collection is not so large as it might otherwise have been, but nevertheless, of the 17 species sent home, two are new and represent *Mus ochraceiventer* and *M. whiteheadi* of Borneo. In my former paper on Messrs. Annandale and Robinson's collection, the synonymy of the various species was brought up to date, and in the present paper reference is given only to those papers that have been published since.

TUPAIA FERRUGINEA Raffles.

Tupaia ferruginea Raffles, Trans. Linn. Soc. xiii. p. 256 (1822); Flower, P. Z. S. 1900, p. 336; Miller, Proc. Biol. Soc. Wash. xiii. p. 193 (1900); id. Proc. U.S. Nat. Mus. vol. xxvi. p. 472 (1903).

a–e. ♂. Pelepak, Johore, March 1905.
f–h. ♀. Pulai, S.W. Johore, Nov. & Dec. 1905.
i–l. ♀. Johore Bahru, Feb. & March 1904.
m. ♀. Woodlands, Singapore, 2nd Aug., 1904.

This species occurs as far north as Tenasserim, where it meets with *T. f. belangeri*, a paler form.

TUPAIA MALACCANA Anders.

Tupaia malaccana Anders. Zool. Res. Yunnan, p. 134 (1879); Bonhote, Fasc. Malay., Zool. vol. i. p. 13 (1903); Miller, Proc. Wash. Acad. Sci. ii. p. 230 (1900); id. Proc. Acad. Nat. Sci. Philad. 1902, p. 157; id. Proc. U.S. Nat. Mus. vol. xxvi. p. 472 (1903).

a. ♂. Kangka Aming, 3rd June, 1905.
b. ♀. Kangka Kuli, 25th Nov., 1904.
c. ♀. S. Malaya, 24th June, 1904.

A series of very typical specimens.

RATUFA AFFINIS (Raffl.).

Sciurus affinis Raffl. (nec Horsf.) Trans. Linn. Soc. xiii. p. 259 (1822).

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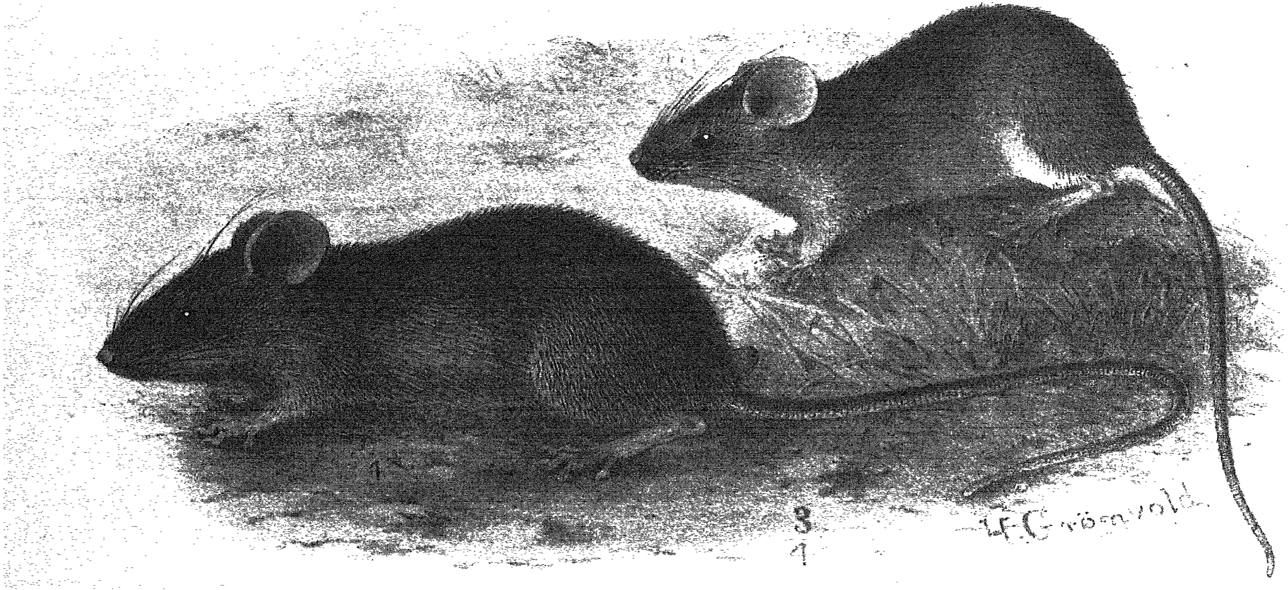
* For explanation of the Plate, see p. 11.



H. Grönvold del. et lith.

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1. MUS INAS 2. MUS KLOSSI

Ratufa affinis typica (Raffles) Bonh. Ann. & Mag. N. H. (7) vol. v. p. 495 (1900).

Ratufa affinis (Raffles) Miller, Proc. Wash. Acad. Sci. vol. ii. pp. 73 & 77 (1900).

a, b. ♂ ♀. Pelepak, Johore, March 1905.

With reference to a note by Mr. Miller (*loc. cit. supra*), I believe that his *R. affinis* is undoubtedly the same as my *R. affinis typica*. In my description of this species I noted that the hairs "*when newly-grown*" were annulated; but this annulation disappears extremely quickly, so that it is very seldom that a specimen in annulated pelage is procured.

With regard to Miller's *R. pyrsonota* described in the same paper, this is the Malayan form of *R. ephippium* from Borneo and is, as Mr. Miller notes, quite distinct from *R. affinis*. It should really be known as *R. ephippium pyrsonota*, which saves any possibility of confusion. Mr. Miller has since 1900 described many new species representing island forms or local races of *R. affinis* or *ephippium*, but, from his strict adherence to binomial nomenclature, which has prevented him from recognising the true specific difference between *affinis* and *ephippium*, it is impossible to tell to which of these species his new races belong, and in consequence to determine the true specific range. I am, however, inclined to believe that they are all races of *R. ephippium*, and that the true *R. affinis* will be found to have a very restricted range, confined to the Malay Peninsula and possibly Java.

SCIURUS TENUIS Horsf.

Sciurus tenuis Horsf. Zool. Res. (1824); Thos. P. Z. S. 1886, p. 76; Flower, P. Z. S. 1900, p. 357; Mill. Proc. Wash. Acad. Sci. ii. p. 211 (1900); id. Proc. Acad. Nat. Sci. Philad. 1902, p. 51?; id. Proc. U.S. Nat. Mus. xxvi. p. 452 (1903).

a–b. ♀. Gunong Pulai, 1500′, Nov. & Dec. 1904.
c. ♀ imm. Mt. Austin, S. Johore, 31st Aug., 1904.
d. ♀. S. Malaya, S. Johore, 24th June, 1904.
e, f. ♀. Woodlands, Singapore, June & Aug. 1904.

These specimens, which are practically topotypes, are therefore of the typical form. This species, however, appears to be a remarkably stable one, Mr. Miller stating that specimens from Sumatra were indistinguishable from topotypes. At the same time *S. tenuis surdus* Mill., from the north of the Peninsula, is distinctly paler and greyer.

SCIURUS VITTATUS Raffles.

Sciurus vittatus Raffles, Trans. Linn. Soc. xiii. p. 259 (1822); Bonh. Fasc. Malay., Zool. vol. i. p. 22 (1903).

Sciurus notatus miniatus Miller, Proc. Wash. Acad. Sci. ii. p. 79 (1900).

Sciurus peninsularis Miller, Smithsonian Miscell. Coll. vol. xlv. p. 10 (1903).

a, *b*. ♂ ♀. Pelepak, Johore, 27th March, 1905.
c. ♀. Kangka Aming, Johore, 26th May, 1905.
d. ♂. Mount Austin, Johore, 31st Aug., 1905.
e. ♀. Johore Bahru, 10th May, 1904.
f. ♀. Pasir Gudang, Johore, 26th Feb., 1904.
g. ♀. Pasir Gudang, Johore, 11th May, 1905.
h. ♀. Woodlands, Singapore I., 15th Aug., 1904.
i, *k*. ♂ ♀. Singapore I., June & Aug. 1904.

Mr. Miller has made two new species of the Peninsula forms of *Sc. vittatus*. He first separated the N. Malayan form from those in the south under the name *miniatus*, and more recently the Southern Peninsula form has been named *peninsularis*, to distinguish it from the typical Sumatran race.

The series sent home by Mr. Kloss has enabled me to reconsider the matter very thoroughly, and has still further confirmed my opinion that this very variable species cannot be split up into the geographical races proposed by Mr. Miller.

To take the case of *S. v. miniatus* first of all. It is characterised, compared with specimens from Singapore Island, by having the red of the under parts much darker and the terminal pencil or sometimes the entire distal half of the tail uniform red beneath. The type locality of this subspecies is given as Trong in Lower Siam, but its exact distribution is not stated.

In the British Museum there are specimens answering to this description from various localities along the whole length of the Peninsula including Singapore Island, so that its distribution would appear to be identical with that of the paler form, as in many localities they are found side by side.

S. miniatus therefore can on no account be considered as a geographical race or true subspecies, and it must be either a distinct species or a mere colour-variety. The fact that intermediates in all stages occur renders its status as a true species impossible; and there are specimens showing on the under parts the deep red of *miniatus* as well as the lighter orange of true *vittatus*. These, then, are the reasons for regarding *miniatus* merely as a colour-variety of *S. vittatus*.

Now as regards *S. peninsularis*. The characters distinguishing it from the true *S. vittatus* of Sumatra are said to be as follows: "more yellowish under parts, less yellowish cheeks," *i. e.* a paler variety.

The *types* of *S. vittatus*, which are in the British Museum, are absolutely indistinguishable from specimens taken in the Peninsula. It should, of course, be noted that Tapanuli Bay, whence Mr. Miller procured his series, which he regarded as typical of *S. vittatus*, is a considerable distance from Bencoolen, the type locality; and the Tapanuli Bay specimens *may* represent a distinct race, but this is most improbable, as this species also varies considerably in Sumatra, since darker specimens with the red tail are also to be found there.

The fact therefore emains that Malay specimens may be identical in all respects with the types of *vittatus*, and since this is the case Mr. Miller's *peninsularis* cannot stand.

It should always be remembered that among truly variable species, of which there are not many, but of which *S. finlaysoni* is another good example, geographical forms are very unlikely to be found: for the fact that it is variable means (i) that natural selection does not restrict it to a particular type; (ii) that in consequence it almost certainly does not breed true. So that, although the majority of individuals in any one place may show a tendency to a particular form of coloration, other varieties will be so frequently appearing as to prevent the fixing of any particular character. Now a true geographic race, to which forms alone trinomials should be restricted, should be the *only* race found in its type locality, intermediates being found only in the country approaching that of another race. It is therefore evident that *S. vittatus* is, as regards colour, a very variable species, and as such it behoves all systematists to be extremely cautious before naming any races thereof.

It is only fair to add that the type of *miniatus* came from the hills at an altitude of about 1000 feet, and may represent a hill form; but at present there is no evidence of this, and such evidence as there is, namely the dark and light under parts being found on the same individual, tends to disprove it.

SCIURUS NIGROVITTATUS BILIMITATUS Mill.

Sciurus bilimitatus Mill. Smithsonian Misc. Coll. vol. xlv. p. 8 (1903).

Sciurus nigrovittatus Horsf., Bonh. Ann. & Mag. Nat. Hist. (7) vii. p. 452 (1901); id. Fasc. Malay., Zool. vol. i. p. 23 (1903).

a. ♀. Pelepak, Johore, 24th March, 1905.
b, c. ♂. Kangka Aming, Johore, 26th May, 1905.
d. ♂. Johore Bahru, 20th Feb., 1905.
e. ♀. „ „ 18th June, 1904.

Mr. Miller has separated the Peninsula and Javan forms chiefly on account of the almost entire absence of the light stripe in the latter. I have been able to examine only one specimen from Java, in which the stripe is certainly almost obliterated. This is, however, by no means the case with the Sumatran form, in which the stripe is very well marked.

FUNAMBULUS INSIGNIS PENINSULÆ Miller.

Funambulus peninsulæ Mill. Smithsonian Misc. Coll. vol. xlv. p. 25 (1903).

a, b. ♂ ♀. Kangka Aming, Johore, 29th May, 1905.

I have placed these examples under Mr. Miller's name, although his description does not exactly agree with specimens from the Peninsula, and it is probable that his single specimen is hardly typical of the Malay form. I was, however, in error when I stated (Fasc. Malay., Zool. vol. i. p. 26) that the Malay and Sumatran animals were indistinguishable, since they are undoubtedly distinct, the former being of a much yellower and warmer tint. On the other hand, Messrs. Stone and Rehn (Proc. Acad. Nat. Sci. Philad. 1902, p. 133) mention a Sumatran specimen as approaching *F. i. diversus* Thos., in which the colours generally are much brighter and the sides of the body nearly pure chestnut. Further Sumatran material is, however, necessary before this matter can be satisfactorily settled.

The following are the races of *Funambulus insignis* hitherto described:—

F. insignis typicus F. Cuv. Mamm. 1821, pl. 233.	Sumatra.
F. i. diversus Thos. Ann. Mag. Nat. Hist. (7) vol. ii. p. 248 (1898).	Baram, Sarawak.
,, *niobe* Thos. ibid. p. 249 (1898).	Pajo, Sumatra.
,, *castaneus* Mill. Proc. Wash. Acad. Sci. vol. ii. p. 217 (1900).	Anambas I.
,, *jalorensis* Bonh. Fasc. Malay., Zool. vol. i. p. 25 (1903).	Bukit Besar, Jalor.
,, *peninsulæ* Mill. Smithson. Misc. Coll. vol. xlv. p. 25 (1903).	Trong, L. Siam.
,, *rostratus* Mill. ibid. p. 24 (1903).	Tina Balu, Batu I.
,, *obscurus* Mill. ibid. p. 23 (1903).	S. Pagi I., Sumatra.

MUS VOCIFERANS, Miller.

Mus vociferans Miller, Proc. Biol. Soc. Wash. vol. xiii. p. 138 (1900); Bonhote, Fasc. Malay., Zool. vol. i. p. 33.

a–k. 7 ♂, 4 ♀. Mt. Pulai S. Johore, Nov. & Dec. 1904 and Jan. 1905.

As stated by Mr. Miller in his original description, this species is similar to *Mus sabanus* Thos., but brighter and with a very long tail. The extreme length of the tail is sufficient to distinguish it from all other members of the *jerdoni* group. It would appear to be somewhat local, as the specimens in this collection are all from Mount Pulai. The following is a short description that may enable this species to be recognised:—

Colour of upper and under parts sharply divided. Above rufous buff, thickly grizzled with black, the black being almost absent on the flanks. Under parts white. Feet brownish with white margins. Tail bicolor and with its terminal portion white.

Skull of typical *jerdoni* group, *i. e.* rather elongated, small for size of animal, bullæ very small.

Dimensions. Head and body 229 mm.; tail 382; hind foot 45; ear 24.

Skull—greatest length 56 mm.; zygomatic breadth 26.

Since the publication of my paper quoted above, Mr. Miller has described several island forms of this species in Smithsonian Misc. Coll. vol. xlv. pp. 28 *et seq.* (1903).

MUS SURIFER Mill.

Mus surifer Mill., Proc. Biol. Soc. Wash. xiii. p. 148 (1900): Bonh. Fasc. Malay., Zool. vol. i. p. 26 (1903).

2 ♂, 7 ♀. Pelepak, Johore, March 1905.
12 ♂, 18 ♀. Pulai, Johore, Dec. 1904 to March 1905.
3 ♀. Kangka Kuli, Johore, 28th Nov., 1904.
♀. Kangka Aming, Johore, 29th May, 1905.
♂. Mt. Lun Chu, Johore, 13th May, 1905.
♀. Johore Bahru, 21st May, 1905.
♂. Kangka Ketcho, Tebraun.

This large series of *Mus surifer* calls for little comment; the examples show a slight variation in size, and the young are much duller in colour, being of a uniform brown (hair-brown, Ridgw.). The adult pelage first appears along the flanks. Mr. Miller's distinction of the white of the foot being cut off from the white of the inside of the thighs owing to the brown colour encircling the ankle, appears to be a perfectly constant feature.

MUS INAS, sp. nov. (Plate I. fig. 1.)

Mus whiteheadi Thos., Bonh. P. Z. S. 1900, p. 880.

The Malayan representative of *Mus ochraceiventer* Thos. Fur long and thickly interspersed with spines. General colour above uniform grizzled rufous (ochraceous rufous, Ridgw.), fading to pale ochraceous (pinkish buff, Ridgw.) on the under parts. Feet and hands brownish white. Tail rather shorter than the head and body, almost naked and bicolor.

Skull. The only skull available is in such a bad state of preservation that a description is impossible.

Dimensions of type (in flesh). Head and body 162 mm.; tail 152; hind foot 31.

Habitat. Gunong Inas, Perak. Also found in Johore.

Type. B.M. 2.11.15.2. Adult ♀. Gunong Inas, December 1899.

The type specimen of this species was erroneously referred by me some years ago to *M. whiteheadi*. The advent of another specimen in the present collection proves it to be sufficiently distinct from the Bornean form to merit description. It may be distinguished from *Mus ochraceiventer* by its more rufous colour above and paler colour beneath, while the tail is very much more markedly bicolor. It is distinguishable from *M. whiteheadi* by its larger size.

MUS KLOSSI, sp. nov. (Plate I. fig. 2.)

The Malayan representative of *Mus whiteheadi* Thos. Fur short, thickly interspersed with spines. General colour above rufous-buff (orange-buff, Ridgw.), grizzled with dark brown, the buff colour becoming purer on the flanks and shading to pale ochraceous (cream-buff, Ridgw.) on the under parts. Feet and hands white. Tail shorter than the head and body, almost naked and bicolor.

Skull of the *Mus jerdoni* type with small bullæ, very similar to that of *Mus whiteheadi* but smaller.

Dimensions (of type in flesh). Head and body 120 mm.; tail 105; hind foot 26; ear 17.

Skull. Greatest length 32 mm.; basilar length 24; palatal length 7; diastema 8; length of incisive foramina 5; length of nasals 11; zygomatic breadth 9; interorbital breadth 5·5; breadth of brain-case at roots of zygomata 13; length of molar series 5.

Habitat. Johore, Malay Peninsula.

Type. Coll. C. B. Kloss, No. 218. Adult ♀. Collected on Mount Pulai, S. Johore, 1600′, on the 31st December, 1904.

This species may be easily distinguished from *Mus whiteheadi*, the only species with which it might be confused, by its paler and yellowish coloration and slightly smaller size. Mr. Kloss has sent over 5 specimens altogether, viz.:—

a, b. ♂ ♀. Pelepak, Johore, March 1905.
c. ♂. Mt. Lun Chu, Johore, May 1905.
d, e. ♀ (one the type). Mount Pulai, Johore, Dec. 1904.

MUS VALIDUS Mill.

Mus validus Mill. Proc. Biol. Soc. Wash. vol. xiii. p. 141 (1900); Bonh. Fasc. Malay., Zool. vol. i. pp. 34 & 37 (1903).

a, b. ♂ ♀. Kangka Kuli, Johore, 24th Nov., 1905.

This species is probably the Malay form of *Mus muelleri*. Mr. Miller in his original description states that this species bears a great external resemblance to *Mus bowersi*; but this is hardly the case, for the general colour of *Mus bowersi* is greyish and its fur is fairly soft, whereas in the species under consideration the general colour is dark brown, each hair having lighter annulations, and the fur is very harsh. *Mus bowersi* has in addition the terminal portion of the tail white, whilst in *Mus validus* the tail is unicolorous and dark.

There are no skulls with these specimens, but the cranial characters have been carefully given by Mr. Miller.

MUS JARAK Bonh.

Mus jarak * Bonh. Journ. Fed. Mal. States, vol. i. no. 3 (1905).

a. ♀. Pelepak, Johore, 6th Jan. 1905.
b, c. ♂ ♀. Kangka, Senibong, S.W. Johore, 10th July, 1905, and 12th Sept., 1904.
d–h. ♂. Pasir Gudang, S.W. Johore, 10th May, 1905.

A series of eight skins sent home by Mr. Kloss proves this species, which I had supposed to be an island form, to occur in the south of the Peninsula. Individuals vary somewhat amongst themselves, some being rather lighter in their general coloration than others, but the lightest have a considerably darker appearance than *Mus jalorensis*.

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* *Mus jarak* nearly allied to *Mus jalorensis*, but darker on the upper parts, the fulvous tips being browner and greatly diminished in size. Type locality, Pulau, Jarak, Str. of Malacca. A full description of this species is published by the Selangor Museum.

They belong, as I pointed out in my former paper, to the *Pyctoris* sub-group of *Mus rattus*, and may be distinguished by their soft fur, medium size, short tail, and *pure white* under parts, the hairs being white to their bases.

MUS GRISEIVENTER Bonh.

Mus griseiventer Bonh. Fasc. Malay., Zool. vol. i. p. 30 (1903).

a–c. 2 ♂, 1 ♀. Pelepak, Johore, March 1905.

d–g. 3 ♂, 1 ♀. Pulai, S.W. Johore, Nov. 1904 and Jan. 1905.

h. ♂. Johore Bahru, 3rd April, 1905.

i–n. 3 ♂, 2 ♀. Kangka Senibong, Johore, Sept. 1905.

o. ♂. Pasir Gudang, Johore, 11th May, 1905.

This is the really common House-rat of the Peninsula; its greyish or yellowish under parts enable it to be easily recognised from *M. jalorensis* or *M. jarak*, the hill forms of *Mus rattus*. In size, too, it is rather larger than the preceding species.

MUS NORVEGICUS Erxl.

Mus norvegicus Erxleben.

Mus decumanus Pall., Flower, P. Z. S. 1900, p. 362.

7 ♂, 9 ♀. Johore Bahru, April, June, and August, 1904.

So far as can be judged, this Rat is apparently found only on the Peninsula in the neighbourhood of shipping.

MUS CONCOLOR Blyth.

Mus concolor Blyth, J. A. S. B. xxviii. p. 295 (1859); Bonh. Fasc. Malay., Zool. vol. i. p. 38 (1903).

a–c. ♂. Pelepak, Johore, March 1905.

d. ♂. Tebraun, Johore, Sept. 1905.

e. ♂. Johore Bahru, July 1904.

f, g. ♂ ♀. Kangka Senibong, Sept. 1905.

h. ♀. Pasir Gudang, May 1905.

MUS MUSCULUS Linn.

Mus musculus Linn. Syst. Nat. xii. p. 83 (1776); Flower, P. Z. S. 1900, p. 362.

a. ♂. Johore Bahru, Feb. 1904.

EXPLANATION OF PLATE I.

Mus inas, p. 9.
Mus klossi, p. 9.

2. Contributions to the Anatomy of the Ophidia. By FRANK E. BEDDARD, M.A., F.R.S., Prosector to the Society.

[Received December 7th, 1905.]

(Text-figures 2–11.).

CONTENTS.

(1) On the Vascular System of the Anaconda, on the Characters of the newly-born Young of *Eunectes notæus*, and on the Differences between the two Species of the Genus *Eunectes*, viz. *E. murinus* and *E. notæus*: p. 12.
(2) Some Notes upon the Venous System of *Python sebæ*: p. 27.
(3) Some Notes upon the Anatomy of *Ilysia scytale*, bearing upon its systematic position: p. 31.
(4) The Structure of the Young *Bitis nasicornis*, with Notes on other Vipers: p. 34.
(5) Considerations respecting the Primitive Structure of the Lungs in the Squamata: p. 41.

(1) *Notes on the Vascular System of the Anaconda, on the Characters of the newly-born Young of* Eunectes notæus, *and on the Differences between the two Species of the Genus* Eunectes, *viz.* E. murinus *and* E. notæus.

The opportunity of examining two newly-born[*] examples of a little-known species of Anaconda, viz. *Eunectes notæus*, is so unlikely to be of frequent occurrence, that I have thought it desirable to make as detailed a study as possible of the veins, while the fact that comparatively little is known of the venous system in the genus *Eunectes* seemed to me to render this study still more desirable. So far as I am aware, some notes by myself[†] upon the intercostal arteries and the anterior abdominal vein are all that has been published upon this genus of Boine snakes so far as concerns the vascular system.

On the other hand, there is abundant material for comparison with the anatomy of the vascular system of *Python*[‡], and less with that of *Eryx*[§] and *Boa*[‖].

External characters of Young.—The newly-born young of this snake retain some of the embryonic veins and the yolk-sac is not completely absorbed. This would appear to be a great disadvantage until we reflect that the Anaconda is so very aquatic an animal that the young are possibly born in the water[¶]. The navel is a very large aperture in the ventral median line, measuring 14 mm. × 9 mm. or 12 mm. × 7 mm. It lies $4\frac{1}{2}$ or $5\frac{1}{4}$ mm. from the vent.

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[*] These young Anacondas were born on Sept. 27, 1905, and one of them was just living when it came into my hands.

[†] "Notes upon the Anatomy of certain Snakes of the Family Boidæ," P. Z. S. 1904, vol. ii. p. 107.

[‡] Hopkinson & Pancoat, Trans. Amer. Phil. Soc. v. 1837, p. 121; Jacquart, Ann. Sci. Nat. (4) iv. 1855, p. 321; Retzius, K. Vet.-Ak. Handl. 1830; Beddard, P. Z. S. 1904, vol. i. p. 362; Panizza, 'Sopra il systema linfatico dei Rettili,' Pavia, 1833 (I have not seen this memoir).

[§] Beddard, P. Z. S. 1904, vol. ii. p. 107.

[‖] Gadow, incorporated in Bronn's Thier. vi. Abth. iii.

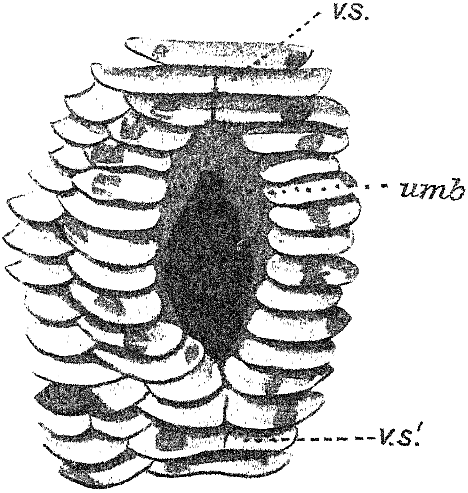
[¶] I am indebted to Mr. Pocock for reminding me of this.

The whole lengths of the two specimens which I have examined were as follows:—Specimen A, 21 inches; Specimen B, 19½ inches. The distance between umbilicus and vent was naturally greater in the larger specimen, and the umbilicus itself larger.

In the above given measurements I regard as the navel not merely the actual aperture in the skin through which the yolk-plug* protrudes, but the whole area which is devoid of scaling. The yolk-plug in the interior of the body extends from the gall-bladder anteriorly to the end of the kidneys posteriorly, and lies above the fat-body. It is a dense solid plug. Meckel's diverticulum arises from it just behind the umbilicus, and enters the small intestine about an inch behind the pancreas.

The umbilicus itself is so exactly median in position (text-fig. 2) that it has divided the epigastric vein, which, instead of lying to one side or the other, forms a loop surrounding it. As elsewhere this vein is single, the position of the umbilicus could, I imagine, be detected in a more fully adult snake by this splitting and rejoining of the epigastric vein.

Text-fig. 2.



Region of umbilicus in newly-born Anaconda (*Eunectes notæus*).

umb. Umbilical area; *V.S.* Ventral scales anterior to umbilicus, which are still divided into two; *V.S'.* Similar ventral scales behind the umbilicus.

In the two newly-born Anacondas the area of the navel embraced nine of the ventral scales, which are split into halves, each half lying on either side of the soft median area. Anteriorly and posteriorly two scales showed a median groove, indicating, it is to be presumed, that they had been originally split, but that the two halves had come together in the course of the gradual obliteration of the area of the navel. Both specimens were practically identical in the disposition of the scales. It is remarkable, however, that in an individual of the same brood measuring 22¼ inches long, and older by three weeks (it died on Oct. 17), the median furrowing of the ventral scales was continued for a long way behind the navel (text-fig. 3). The actual area of the navel, much narrower in this specimen, corresponds to seven scales. This older individual is a male, as shown by the shape of the cloacal claws; I did not dissect it.

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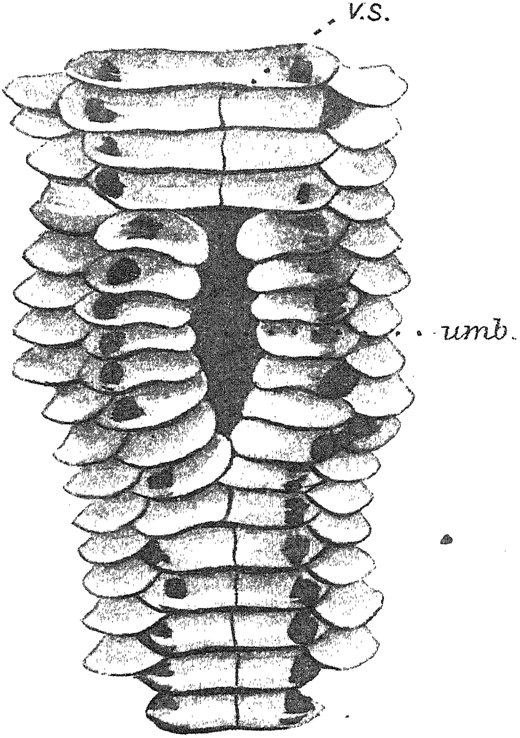
* Messrs. Mole & Urich (P. Z. S. 1894, p. 505) mention the existence of "traces of the umbilical cord" in newly-born *Eunectes murinus.*

Text-fig. 3.



Region of umbilicus in a young Anaconda (*Eunectes notæus*). Lettering as in text-fig. 2.

Current treatises on Zoology have largely ignored the fact that among the Boidæ the rudiments of hind limbs offer sexual characters which are unmistakable. They are obvious, for instance, in the genus *Eryx*, and in the species with which I am concerned, viz. *Eunectes notæus*. That this fact is obviously not generally known is perhaps due to Duméril and Bibron. These authors, in their classical 'Erpétologie Générale,' vol. vi. 1844, remark, in a general sketch of the Pythons and Boas, upon the investigations of Mayer on the rudimentary hind limb, but say nothing as to sexual differences in form of the "ergots," *i. e.*, claws in which these limbs terminate. Later on they write of *Eunectes murinus* (p. 531):—"Ergots coniques, courts, recourbés et pointus," stating also that they are "d'une très petite dimension chez des femelles ayant plus d'un mètre de long." In *Boa* again (p. 503) it is said that these claws are present, but "néanmoins plus développés chez les mâles chez les femelles." The inference from these observations would surely be that while sexual differences exist between individuals in respect of those claws, they are merely a matter of varying magnitude. It was possibly for this reason that text-books, at least those which I have referred to, have not noticed the matter. In the adult male *Eunectes notæus* there is a very conspicuous pair of claws, which are sharply pointed, compressed, and curved, the lower surface being ridged. In the adult female there is not a claw at all, but a bluntly conical straight process, quite unlike the claw of the male. In both cases, however, this terminal process is ensheathed in two bract-like scales. In the young individuals the differences are as well marked as in the adult.

The mental groove in the young Anacondas differs from that of the adult male. In both adults the mental groove was bordered by five scales on each side. The two individuals, a male and a female, appeared to be identical in the disposition of these scales.

In the two youngest individuals, which died immediately on birth, the conditions were as follows:—In one snake, on the right side the mental groove was bordered by only three scales; but the middle one was very large, and indentations appeared to show that it was in reality composed of three. On the left side there were only four scales bordering the mental groove, but the anterior one of these was partly divided into two; thus the total on both sides is really five as in the adult. The second specimen was identical on the right side, but on the left the second scale, and not the first, was obviously composed of two. In the young Anaconda which lived for three weeks* there is a still closer approximation to the conditions observable in the adult. On the left side of the mental groove all five scales are separated; on the right there were four scales, the second being much the largest and obviously representing two.

Kidneys.—The kidneys of these young *Eunectes* have a form which is remarkable. It is illustrated in the accompanying figure (text-fig. 4, p. 17). The part of the kidney which apparently corresponds to the whole kidney of other Snakes has the usual form which is characteristic of Serpents and needs no particular remark. The kidney does not, however, end off in front without much diminution of diameter. It suddenly narrows to form a slender forward prolongation, which is as long as, or longer than, the posterior region of the kidney. There is no break whatever between these two sections; and their appearance as regards texture and colour is identical. The thinner anterior part of the kidney may pehaps be a mesonephros, persistent in these young forms. On the two sides of the body the two kidneys differed very considerably in dimensions. The right kidney is, as in other Snakes, more advanced than the left kidney, and its anterior end actually passes a trifle beyond the gall-bladder and all but reaches the liver. This kidney is altogether 108 mm. long, of which 44 mm. belong to the posterior broad region of the gland, the slender anterior portion being thus much the longer. The right-hand kidney is altogether only 92 mm. long, and the broader posterior region is here the longer of the two sections, measuring as it does 48 mm.

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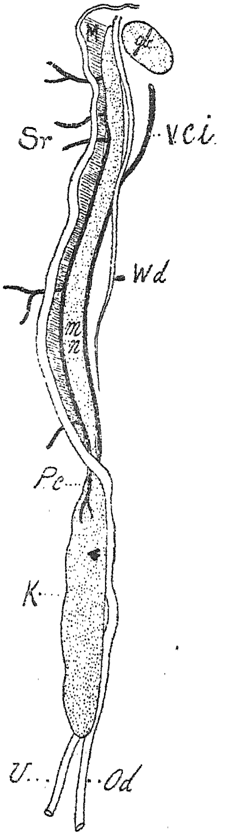
* This specimen shed its skin at any rate once, which doubtless accounts for the change, not therefore referable to individual variation.

The slender anterior prolongation of each kidney is not, of course, to be confounded with the adrenal body. This latter is plainly distinguishable from the kidney-tissue by its yellow colour and different texture. It lies in the middle section of the anterior region of the kidney.

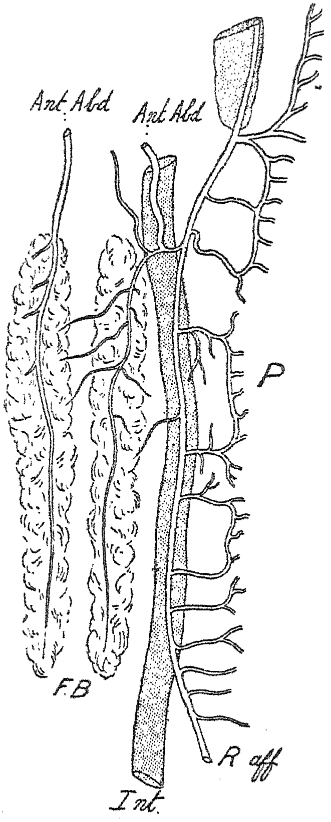
The gonads were not visible in either specimen. But I believe them both to be females. This conclusion was arrived at owing to the nature of the gonad-ducts. These ducts were of comparatively large calibre and without the close windings of the male ducts Moreover they were prolonged forward in the case of the right-hand one to a point anterior to the gall-bladder where the duct appeared to end freely. In the region of the anterior portion of the kidney the duct was attached by an evident though narrow mesentery to the substance of the kidney. The actual course of the gonad-duct of the right side is shown in the figure annexed (text-fig. 4, p. 17). Anteriorly it lies to the outside of the kidney. At the junction between the anterior more slender and the posterior stouter region of the kidney it crosses over and lies to the inside of the kidney.

The diameter of this tube appears to me to be too great to allow of its being identified with the sperm-duct. Another and, as I believe, very strong reason forbids this identification. To the inside of each kidney, along the anterior thinner region of that organ only, is a more slender duct than the gonad-duct, which, however, presents the same general appearance. This duct commences some way in front of each kidney, but the exact mode of its commencement I have been unable to ascertain. It follows the kidney fairly closely, lying on the opposite side to that occupied by the gonad-duct, to a point some little way in front of the junction between the anterior and posterior sections of the gland, and there gradually disappears. It seems to me that this structure must be unquestionably homologised with the mesonephric duct; and if so, the gonad-duct can hardly be the sperm-duct. That it is the mesonephric duct seems to be necessary from the impossibility of identifying it with anything else; and if so, then the section of kidney along which it lies is possibly to be looked upon as mesonephros, the incorporation of which with the metanephros has perhaps caused the withering of the end of the tube, no longer needed as a secretory conduit.

Text-fig. 4.



Text-fig. 5.



Text-fig. 4.—Kidney and adjacent organs in newly-born Anaconda (*Eunectes notæus*).

g.b. Gall-bladder; *K.* Kidney; *M.* Mesentery attaching oviduct to *mn*, mesonephros; *Od.* Oviduct; *P.c.* Posterior cardinal vein arising on kidney (?); *Sr.* Suprarenal portal veins; *U.* Ureter; *v.c.i.* Vena cava posterior or renal efferent vein; *Wd.* Wolffian duct.

Text-fig. 5.—Renal afferent vein of left side of body and its connections in newly-born Anaconda (*Eunectes notæus*).

Ant.Abd. Anterior abdominal veins; *F.B.* Fat-bodies from one of which the right anterior abdominal seems to arise; *Int.* Intestine; *P.* Parietal branches of *R.aff.*, renal afferent, which is seen to reach kidney anteriorly.

I have had the opportunity of comparing the structure of the kidneys in the two young *Eunectes notæus* with the structure of those of an adult male of the same species. There is in the adult no forward prolongation of a narrower region of the kidney. The organs are of the normal Ophidian form, of equal diameter throughout, and ending anteriorly in a blunt rounded extremity. That there may have been some microscopic traces in the tissues surrounding the sperm-duct is of course possible; but there was nothing obvious to the naked eye. This state of affairs in the adult snake confirms, as I think, my opinion that the narrow anterior region of the renal organ in the newly-born young is to be looked upon as mesonephros. I may observe that the testes are very long bodies, and that that of the right side extends as far forward as the gall-bladder. The growth of the testis may account for the disappearance of the mesonephric portion of the renal organ. With the disappearance of the supposed mesonephros there is correlated, perhaps in this species but not in some other Boids, the disappearance of the posterior cardinal vein, which, as I describe in this paper, accompanies that gland in the young snakes.

Umbilical Vein.—The umbilical vein was not absorbed in either specimen. I was able to trace it along its whole course in the body from the navel onwards to the anterior end. The conditions which obtain in this snake show that Prof. Hochstetter's discovery of the independence of the umbilical vein from the anterior abdominal of the adult applies to *Eunectes* as well as to the reptiles (*Lacerta* and *Tropidonotus*) whose development he studied. There were two veins to be seen running from the umbilical aperture. The right-hand vein had the longest course, and is, I take it, the representative of the right umbilical vein. The second vein was traced along Meckel's diverticulum to the alimentary canal, where it joined the portal system. This vein is, as I think, the omphalo-meseraic. The umbilical vein pursues a straight course between the two fat-bodies and over the gall-bladder. Arrived at the liver, it passes beneath this organ, between it and the ventral body-wall. There were no branches to be detected anywhere, and there was certainly no connection between the vein and the two anterior abdominal veins at any point that I could ascertain. Indeed it was easy to observe the umbilical vein running across the anterior abdominals. The vein is fairly closely attached to the ventral parietes in the region of the liver. It gives off no branches to the liver, with which it has no relations save those of superposition. At the extreme anterior end of the liver the umbilical vein joins the vena cava posterior just where the latter emerges from the liver. The two then run as one vessel to the heart. It is for the reason that the umbilical vein joins the vena cava that I regard it as the right-hand of the two primitive umbilicals. For in Hochstetter's figure* illustrating the relation of these various veins in the fœtal snake, the right-hand vein is depicted as joining the vena cava, while the left-hand vein is lost in the liver plexus. The umbilical vein was turgid with blood and of equal calibre with the efferent renals or other principal blood-vessels of the reptile. It is noteworthy that the umbilical vein until it reaches the region of the liver appears to run in an accurately median course. This clearly suggests that only one umbilical vein is present. In any case only this vein is obvious, unless the vein identified by me above with the ophalomeseraic be really the left umbilical.

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* Morph. Jahrb. xix. 1892, pl. xvii. fig. 15, V.u.d. and V.u.s.

In any case it is clear that this vein belongs to the fœtal circulation, inasmuch as it passes through the navel to the fœtal membranes, and that it has nothing to do with what are usually held to be the equivalents in the Ophidia of the anterior abdominal vein or veins in other reptiles. A remarkable fact about this vein is not merely its presence in the young when born and able to feed for themselves, but its persistence in the fully adult snake. In an Anaconda* (*Eunectes murinus* ♂) dissected in May 1904, which was acquired by the Society in 1899 as an adult, I found a vein ending on the fat-body posteriorly which ran over the liver (*i. e.* ventrally of it), but did not draw blood from that organ anywhere, and emptied itself into the vena cava anteriorly shortly after that vein had freed itself from the liver. It is plain that this vein is that which I call umbilical in the young Anacondas. I have no record of such a vein in *Python*, nor is one figured by Jacquart † nor by Gadow ‡ in *Boa*.

It seems quite certain that this vein is the homologue of that vein in Birds which passes between the lobes of the liver, recurring in the falciform ligament. Hochstetter has proved § that the vein in question, variously termed "anterior abdominal," "epigastric," and "umbilical," is the persistent umbilical vein of the embryo. It follows therefore that it cannot be the homologue of the anterior abdominal vein of the Lacertilia, which has been shown to be a new structure, having nothing to do with the fœtal umbilical vein. There are therefore among Sauropsida two morphologically distinct veins or systems of veins which convey blood along the ventral surface from the posterior region of the abdomen to the liver or to the hepatic vein, and which are undoubtedly superficially similar, so much so that embryology alone has been able to decide the question of their distinctness.

The coincidence of these two veins in *Eunectes* solves the problem so far as concerns that species. At present so little is known of the venous system in the Ophidia, so few types have been examined from this point of view, that so far the Anaconda is the only snake in which the two forms of abdominal vein have been met with together. It is impossible therefore to build up much in the way of an attempted explanation without further facts. In the meantime the facts suggest that *Eunectes* offers a transitional state of affairs between the retention of the umbilical vein as the vein of the abdomen and its replacement by the subsequently developed anterior abdominal. It is exactly analogous to the relations between the posterior cardinals and the vena cava. In the primitive *Ceratodus* we have one cardinal persisting in its entirety and at the same time an undoubted vena cava posterior*. In higher types the posterior cardinals are more or less rudimentary, and the vena cava alone is concerned with the circulation of the region of the body formerly served by the cardinals.

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* Since this paper was written I have found the vein in a second adult male *E. murinus*.

† Ann. Sci. Nat. (4) iv. 1855.

‡ Bronn's Thierreich, Bd. vi. Rept. Abth. iii. Schlangen.

§ Morph. Jahrb. xiii. 1888, p. 575.

Replacements of this kind are familiar to morphologists in connection with many organs.

It is not without significance, in my opinion, that this state of affairs has been discovered in a snake, and especially in an undoubtedly primitive snake. That the Squamata form one group is probably the opinion of every zoologist at present. It is further clear that no existing group of Lizards is much nearer to the snakes than any other. The origin of the Ophidia must have been from some earlier type. This may land us some way back in the history of a group which with *Hatteria* appears to me to represent the archaic reptilian structure more than any existing group of Reptiles. It is possible that in the extensive fat-body of snakes we have the cause of the origin of the double anterior abdominal veins. The only fragment of evidence, however, which points to a large fat-body as a character of the ancestral Squamata is its large size in *Amphisbœna* †. But this evidence is not to be neglected. The growth of the abdominal veins would render the umbilical superfluous, they taking on its function of drawing blood from the body-walls.

System of Anterior Venœ Cavœ.—The veins of the anterior region of the body consist of four main trunks, which of course unite in pairs to form the two superior cavæ. The left tracheal unites with the left anterior vertebral and each right-hand vessel. It is noteworthy that the two anterior vertebral veins run superficially at equal distances from the median anterior vertebral artery. Each vessel lies in a furrow between longitudinal bands of musculature. The vertebral vein receives a large branch from the parietes just before joining the tracheal vein; the conjoined vein then receives just before its entrance into the heart the azygos, which is only present upon this side of the body. The azygos is short, and only collects blood from four intercostal spaces. Of the four branches which constitute it, one is especially large, and comes off exactly opposite to the point of entrance of the azygos into the Ductus Cuvieri. In the second specimen the azygos was much the same.

Epigastric Vein.—This vein has already been referred to in connection with its perforation by the umbilical aperture. It is as well developed as in the Ophidia generally, and lies, as in other snakes, immediately above the middle line of the body. Its posterior connection I did not see in either of the specimens. In the region of the liver, this vein has two connections with the hepatic portal system, and two only that were visible, which were identical in both specimens and which therefore may be looked upon as distinctive of the species. One branch from the vein joined the main portal stem a little behind the point where it reaches the liver. The other branch of the epigastric connected with the hepatic portal system lies a long way anteriorly and enters the liver-substance approximately in the middle line, a very little way behind the anterior termination of the liver. I saw no other veins passing from the epigastric to the liver. But in an adult *Eunectes murinus* there were four or five veins entering the liver between these two. It may be that the existence of two only in the young *Eunectes notæus* is a mark of immaturity.

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* See W. B. Spencer, in "The Macleay Memorial Volume" published by the Linnean Society of New South Wales, 1893.

† v. Bedriaga, Arch. f. Naturgeschichte, Jahrg. 50, 1885, pl. iv. fig. 2, Fk.

Afferent Renal Veins.—The caudal vein emerging from the tail receives branches from the cloaca, of which I am not able to give a particular account, as this region got damaged in displaying the course of the main trunk of the vein. The vein runs close to the large intestine on the left side, and receives in its course to the left kidney a series of veins from the parietes to the left of the dorsal median line (text-fig. 5, p. 17). I counted altogether twelve of these before the vein enters the kidney, of which it is the afferent renal. On the right side the afferent renal seems to have no direct connection with the caudal vein, but the anastomoses between veins in this region are so numerous that there is doubtless an actual connection between them. Still there is no such direct continuity as obtains on the left side. It is also to be remarked that the right renal afferent vein is a very distinctly smaller vein than its fellow of the left side, and in correspondence with this the affluents from the parietes which join it are much less conspicuous than those of the left side.

The figure (text-fig. 5, p. 17) shows the series of veins from the parietes which enter the left renal afferent vein. And an inspection of this figure will render unnecessary a detailed description of the veins in question. It may be remarked, however, that there is a tendency for them to be connected together by a longitudinal trunk which is not present throughout the whole extent of the series, but gets to be more pronounced anteriorly. These parietal veins moreover vary in importance, some being much more slender than others. The most prominent of the whole series enters the afferent renal just before the latter enters the left kidney. This vein is connected with a very conspicuous longitudinal trunk (text-fig. 6, p. 23) which runs along the whole length of the kidney, being stouter at the two ends of that organ and more slender in the middle; it is, however, nowhere deficient. There is a general correspondence between the numbers of these parietal veins on the two sides of the body; but, as has been remarked, the most noteworthy difference is that the veins of the right side are more slender than those of the left, and this applies also to the section of the parietal system which runs along the outer border of the kidney.

In the second specimen, the longitudinal vessel running to the outside of each kidney was not marked, at least on the right side of the body. The same large vein enters the afferent renal just before the latter reaches the kidney. Towards the anterior end of the kidney the veins of five or six intercostal spaces join together and form a single trunk, which does not extend beyond the kidney but appears to plunge into the substance of that organ. There is thus an accessory renal portal system formed which is exactly like that which characterises *Amphisbæna*[*]. These vessels are represented in the first of the two specimens which I dissected; but in that individual they are connected with the thinner anterior section of the kidney and with a vein which runs along that region of the kidney. In the second specimen, the vein distinctly opens into the posterior thicker region of the kidney and some way behind its anterior termination. In this example, moreover, the right afferent renal is traceable back along the intestine for a much shorter distance than in the other specimen. The posterior continuation indeed assumes the form of an inconspicuous branch of the stout parietal vein which joins the renal afferent just before its entrance into the kidney.

The afferent renal trunk is also partly fed from the intestinal walls. Slender branches enter the transversely running affluents of that vein.

It is evident that the renal afferent system shows the same asymmetry that we see in the hepatic-portal system; that is to say, that the system of longitudinal parietal vessels connected with the afferent veins are developed only upon the left side of the body.

Afferent Suprarenal Veins.—These veins arise, as in other reptiles, from the dorsal parietes, near to the middle, and are a continuation of the series which supply the liver in front and the kidneys behind. They are, however, unlike the hepatic series, developed upon both sides of the body. These vessels are connected with a slender vein which runs from the anterior end of the broader region of the kidney along the "mesonephros" to the neighbourhood of, and behind, the gall-bladder. This vessel, which exists in other reptiles[†], is, as I think, a portion of the right posterior cardinal, the corresponding vessel on the left side of the body being of course the left cardinal vein. I am not positive that this vessel is continuous all the way along the mesonephros; but it is to be found at any rate for considerable stretches. Into this longitudinal vein open the afferent vessels from the parietes. I counted five of them altogether, of which two at any rate are fed each from two intercostal spaces. Inasmuch as the actual suprarenal body does not extend along

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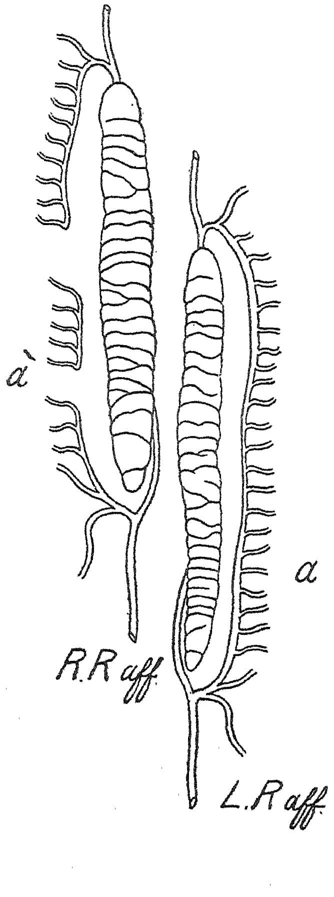
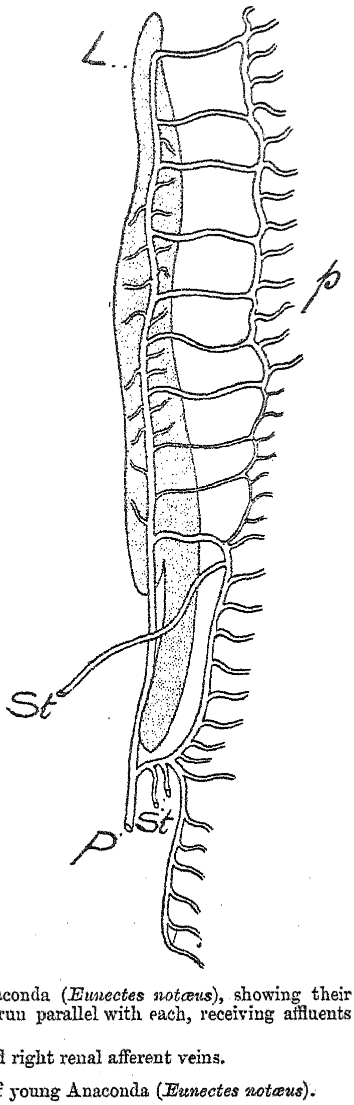
[*] P. Z. S. 1905, vol. ii. p. 485.

[†] E. g. *Amphisbæna*, cf. Beddard, P. Z. S. 1905, vol. ii. p. 486.

Text-fig. 6.



Text-fig. 7.



Text-fig. 6.—Kidneys of newly-born Anaconda (*Eunectes notæus*), showing their lobulation and veins (*a* & *à*), which run parallel with each, receiving affluents from body-wall.

L.R.aff., *R.R.aff.* Left and right renal afferent veins.

Text-fig. 7.—Liver and portal veins of young Anaconda (*Eunectes notæus*).

L. Liver; *P.* Portal vein running along surface of liver and receiving, *p*, branches from parietes, which unite on their own account to form a continuous longitudinal trunk, and branches, *St.*, from stomach.

the whole of the mesonephros, and as the blood-vessels arising from the parietes do extend along at any rate very nearly the whole of the mesonephros, as does the longitudinal vein into which they pour their contents, it would appear that these suprarenal afferent portals are also concerned with the blood-supply of the mesonephros, *viâ* the remains of the posterior cardinal. The suprarenal portals are thus not veins especially destined for the suprarenal circulation, but originally merely the parietal branches of the cardinal. On the left side I found only three of these veins.

Precisely the same series of modifications appear to have proceeded in the case of the liver and of the parieto-hepatic portals. In the Anaconda for example, and for the matter of that in all snakes, as it appears, that have been hitherto examined anatomically, the portal vein extends along the liver nearly to its anterior end. This is shown plainly in the figure of the circulatory system of the Python given by Jacquart*. Into this portal, which runs along the lower surface of the liver, open all or most of the vessels bringing blood to the liver from the parietes. In the same way in certain Lizards (for instance, *Amphisbæna*, *Ophisaurus*, and *Hatteria*) there are at least considerable traces of the same forward extension of the portal. Finally we get the stage which characterises the majority of the Lacertilia, so far as existing knowledge allows us to say, in which the portal enters the liver at its posterior extremity and is not continued forward as a continuous trunk. In these lizards the parieto-hepatic portal veins enter the liver directly, instead of indirectly through the portal vein.

Dorsal Parieto-hepatic Veins.—These veins are entirely developed upon the left side of the body in both specimens. They are, as in other snakes, very highly developed, and a great portion of the blood of the whole body must be contained in them. I describe them only in one specimen; they appeared to be much the same in the other. The first of these veins, advancing from behind forwards, joins the portal vein about on a level with the extreme end of the liver, one lobe of which reaches considerably further back than the other. It is one of the largest of the dorsal parieto-hepatic veins and on reaching the neighbourhood of the body-wall divides into a forwardly running and a backwardly running branch. Just before this division the vein receives twigs from the stomach. The backwardly running branch supplies seven intercostal spaces. The forwardly running branch supplies nine intercostal spaces before the second trunk arises which joins the portal vein just in front of the end of the shorter liver-lobe. As in other snakes, the portal vein runs superficially along the liver, giving off twigs right and left to the liver itself and receiving the dorsal parieto-hepatic vessels. Of these vessels (see text-fig. 7, p. 23) I counted nine in addition to the two that have already been described. At their dorsal extremities these vessels are put into communication with each other by a continuous longitudinal vessel which is an extension forwards of the first dorsal parieto-hepatic already mentioned. Some, if not all, of the dorsal parieto-hepatic veins (which vary considerably in calibre) are joined by branches from the stomach. In addition to these special branches reach the stomach from the parietal longitudinal trunk. Although the parietal longitudinal trunk which collects blood from the parietes and transmits it to the liver runs on the left side only and has no fellow on the right side, it receives intercostal twigs from the right side. It is to be noted that the continuous longitudinal trunk lying on the parietes is characteristic of the Boidæ in general, though I am not able at present to assert that it differentiates them from other snakes.

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* Ann. Sci. Nat. (4) iv. p. 321.

Note upon certain Structural Differences between the Species of Anaconda, Eunectes murinus *and* Eunectes notæus.

Hitherto the species *Eunectes notæus*, the Southern Anaconda, has been distinguished from its ally the more common form by its lighter colour and by the markings generally, into which I have no occasion to enter, as they have been dealt with by its describer, the late Prof. Cope [*].

I have found in dissecting examples of the two species that there are certain differences in the viscera which seem to distinguish also the two species from each other. Upon one of these differences I lay more stress than upon the other, because I have been able to verify it in two examples of *Eunectes murinus* and three examples of *Eunectes notæus*, including among the three the two young specimens which form the subject of the present communication. This difference concerns the pancreas and spleen. In *Eunectes notæus* the pancreas is a large bilobed gland which lies in close contact with the duodenum and remote from the spleen, which is on a level with the front end of the gall-bladder.

In two specimens of *Eunectes murinus* I find the following arrangement of these two viscera:—In both the pancreas is divided into two parts, of which one is situated, as is the whole pancreas in *E. notæus*, close to the intestine. There is also another piece of pancreas lying in front of and in contact with the spleen, which itself has much the same position that it has in *E. notæus*. The duct from the anterior part of the pancreas runs to and buries itself in that piece of the pancreas which lies in juxtaposition to the gut. In addition to this difference, I find in both specimens of *E. murinus* one or two splenculi in the neighbourhood of the spleen and anterior portion of the pancreas. I presume these to be splenculi on account of their colour and general appearance. A dissociation therefore of the pancreas into discrete portions is accompanied by that of the spleen. Upon this anatomical difference I lay some stress, inasmuch as it is to be found in more than one example of each species.

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[*] P. Acad. Nat. Sci. Philad. 1862, p. 70.

Another apparent difference I mention, although I have only noted it in one specimen of each of the two species under consideration, as it could hardly be ascertained in the case of the newly-born young. This fact concerns the gall-bladder. In *Eunectes notæus* the gall-bladder gives rise to two ducts lying side by side and arising independently from the bladder. These branch and anastomose in a moderate way with each other and with the hepatic duct. The latter is single, but in the neighbourhood of its junction with the cystic ducts it gives off twigs which form a network alongside of the main duct which is obvious as such. Three ducts pierce the pancreas on their way to open into the gut. In *E. murinus*, on the other hand, four cystic ducts arise from the bladder and form in the same way but a slight rete. There are, however, two distinct hepatic ducts running side by side from the liver. Three of the cystic ducts join almost immediately to form a single duct, so that the difference from *E. notæus* is not so very marked.

In showing difference in the structure of the pancreas between different species this genus is like *Python*, where the discrete multilobate pancreas of "*P. bivittatus*"* contrasts with that of some other species.

Résumé.

It may be convenient to briefly recapitulate the main facts in the foregoing pages.

(1) The young of *Eunectes notæus* are produced alive and with considerable remains of the yolk-sac.

(2) They possess a mesonephros quite continuous with the kidney, and (female) a mesonephric duct extending along the greater part of the mesonephros and reaching beyond it anteriorly.

(3) The umbilical vein of the newly-born young persists in the adult (*Eunectes murinus*) and is quite independent of the anterior abdominals.

(4) The anal "claws" in *Eunectes notæus* (and in some other Boidæ) offer distinct sexual characters, differing in form in the two sexes. These characters are recognisable in the newly-born young.

(5) The suprarenal portal vessels open into a continuous slender trunk running along the mesonephros and ending on the kidney posteriorly. Their "portal" character is thus secondary.

(6) The vessels which collect blood from the parietes and join the portal systems, whether of the liver, kidneys, or suprarenal bodies, are mainly, and in the case of the liver exclusively, affluents of the left-hand system of veins and arise exclusively or almost so from the left parietes.

(7) Both the liver and the left kidney are supplied from a continuous longitudinal parietal vessel which receives the branches from the body-wall and transmits the blood by a series of branches to the portal vein or to a longitudinal vein connected with the

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* See fig. in Bronn's Thierreich, Bd. vi. Abth. iii. pl. cxxxii. fig. 6 (copied from Poelman). The identity of the species seems uncertain.

kidney. These longitudinal parietal vessels are upon the left side of the body.

(8) As in *Eunectes murinus*, the left anterior abdominal trunk only is connected with the afferent renal of its side*. The right-hand trunk arises from a plexus on the gut.

(9) The azygos vein is short and developed on the right side only.

(10) Attention is called to anatomical differences between the two species of *Eunectes*, which concern the division of the pancreas and spleen in *E. murinus*, these organs being in one piece in *E. notæus*.

(2) *Some Notes upon the Venous System of* Python sebæ.

It might perhaps be supposed that after the apparently exhaustive survey of Jacquart † hardly anything concerning the venous system of *Python* remained for description. Nevertheless M. Jacquart has not dealt fully with a few points of which the importance was perhaps less apparent at the time when he wrote than at present. Since M. Jacquart's memoir, which is abundantly illustrated, nothing concerning the vascular system in this genus has been published except a few notes by myself ‡ in a paper dealing mainly with the arteries of a number of genera of Ophidia. Those notes, however, refer to *Python spilotes*. My present communication refers, as did the memoir of Jacquart, to *Python sebæ*.

I have dissected during the past year or two three individuals of this snake, of which one only was specially favourable for the study of the venous system, owing to its fresh condition and the turgescence of the veins. It was possible in this individual to follow the smaller branches of the veins with ease, and no injection could have produced so favourable a state of affairs for examining the relations of veins.

Having so recently studied in detail the anatomy of the venous system of the Anaconda §, my object has been to compare and is to set down the differences and resemblances between these two genera of Boidæ—types as they are of the two subfamilies, Boinæ and Pythoninæ, into which systematists have divided the family. The validity of comparisons having a purely classificatory aim is of course to some extent affected by the undoubted fact that species of the same genus among the Boidæ may show rather important differences in their veins, as I have been able to demonstrate in the case of *Eryx* ‖.

Afferent Renal Veins and Posterior Cardinals.—In *Amphisbæna* ¶

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* It is necessary to emphasise this agreement between two species of the same genus, since in *Eryx* there are specific differences in this respect between *Eryx jaculus* and *E. conicus*, as I have shown (P. Z. S. 1904, vol. ii. p. 119).

† Ann. Sci. Nat. *loc. cit.*

‡ P. Z. S. 1904, vol. i. p. 362.

§ See above.

‖ P. Z. S. 1904, vol. ii. p. 107.

¶ P. Z. S. 1905, vol. ii. p. 485.

and *Eunectes*[*] I have described a vein running along the sperm-duct and receiving branches from the parietes which are the equivalents of the supra-renal portal vessels of other Reptiles. This vein in the two genera mentioned is no doubt the equivalent of a vein described and figured by Hochstetter in *Varanus*[†] which also accompanies the sperm-duct. In both *Amphisbæna* and *Eunectes*, as it appeared to me, the vein gradually died away anteriorly and arose posteriorly from the substance of the kidney, being not in any direct communication with any of the principal longitudinal veins of the body. It appeared to me nevertheless to be probably the homologue of the posterior cardinal veins of the embryo, diminished in size and functionally replaced by the renal efferent veins or venæ cavæ posteriores or inferiores. It was the general relations of this vein on either side to the mesonephric region and to the parietes which led to this opinion. The conditions which obtain in *Python sebæ* amply confirm this point of view, and, as I think, settle the matter as certainly as it can be settled in the absence of embryological data.

The surface of the kidney shows in this specimen the course of the various vessels which traverse it in the clearest fashion. The single renal artery comes to lie on the kidney close to the anterior end, and can be traced back beyond the kidney to the ureter. The efferent renal vein begins quite near to the posterior end of the kidney, and runs forward, increasing in volume. It is quite distinct, of course, from the afferent renal, which runs not only to the extreme anterior end of the kidney, diminishing in volume as it proceeds, but is continued beyond; it becomes, in fact, the vein which I have already spoken of as the probable equivalent of part of the posterior cardinal. The anatomical facts which have just been detailed seem to me to prove that this interpretation of the vein is the just one. It is quite possible that the examination of rather better material of the two genera to which I have referred in comparison with *Python* might show a continuity in their case also. In any case it is quite obvious in *Python sebæ* and beyond the possibility of error. The only instance of this forward extension of the afferent renal in another snake (*Zamenis gemonensis*) has been recorded by myself[‡], where, however, it is short and plunges at once into the body-wall, this portion being, of course, the equivalent of the parietal branches of *Python* and *Eunectes*.

Umbilical Vein.—I have pointed out that in *Eunectes* the umbilical vein is not merely a vein of the fœtal circulation, but that it persists in the adult, at least in *Eunectes murinus*, where I noted the existence of the vein before the study of the newly-born *Eunectes notæus* enabled me to fix its homologies. It becomes, therefore, a matter of interest to enquire how far this vein is represented in other Snakes. I have found in *Python*

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[*] See above p. 21.
[†] Morph. Jahrb. xix. 1892, pl. xvi. fig. 17.
[‡] P. Z. S. 1904, vol. ii. p. 117.

sebæ what I believe to be the remains of this vein. Along the course of the vena cava posterior, about midway from the anterior termination of the liver and the entrance of the vein into the auricle, is a branch of the vena cava, which is of some thickness and runs for a very short distance ventrally. Here its calibre lessens abruptly, and it becomes continuous with slender veins which run to the ventral parietes and are a part of the epigastric system. It is the large size and the sudden alteration in the calibre of the part of this affluent of the epigastric which joins the vena cava which lead me to infer that this end portion is the persistent umbilical. It is, however, further away from the liver than the umbilical vein is in *Eunectes*. I am not able, therefore, at present to do more than suggest the homology which further facts may substantiate [*].

Anterior Abdominal Vein.—The condition of this vein in *Python sebæ* presents one feature of considerable interest. In an earlier communication [†] I pointed out that the observations of Jacquart as well as myself tended to show that it is only among the Boine Snakes that the anterior abdominal vein is directly connected with the renal afferent veins, as they always are among the Lacertilia. In *Eunectes* (both *E. murinus* and *E. notæus*) it is only one of the two roots of the anterior abdominal which is thus connected, and that of the left side. The right origin of the anterior abdominal is from a plexus of venules upon the gut. I quoted Jacquart to the effect that this also is the arrangement in *Python*. Having examined *Python sebæ* with great attention in regard to this important matter, I am able to state that that snake differs from *Eunectes* and agrees with *Eryx jaculus* in that both roots of the anterior abdominal are connected each with one of the two renal afferents. The veins in question can be easily observed on dissection to lie dorsally of the forwardly-directed rudiment of the pelvic arch, which thus conceals a portion of each vein when seen after the serpent is opened in the usual way from the ventral surface. *Python*, at least *P. sebæ*, is therefore quite Lacertilian in the disposition of these vessels, and the opinion that the Boidæ generally come nearer to the common starting-point of both Ophidia and Lacertilia is strengthened by this observation.

In view of accumulating facts concerning the venous system of Snakes, it is important to notice all variations so as to arrive at the normal characteristics. I may therefore mention that, as Jacquart and I have previously stated, the anterior abdominal of *Python sebæ* divided to form two tubes during its course. In the individual upon which I report here, the division commenced at a point about opposite to the middle of the left kidney. The tubes reunited behind the gall-bladder. The anterior abdominal, as in other individuals, unites with the portal a little way in front of the gall-bladder It is to be noted, therefore, that *Python* differs from *Eunectes* in that the anterior abdominal of the latter remains double for some distance forwards after its origin, while in *Python* the roots join at once to separate and rejoin later.

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[*] See below, p. 35.

[†] P. Z. S. 1904, vol. ii. p. 116.

Azygos Vein.—As in *Eunectes*, the azygos vein of *Python sebæ* is retained upon the right side only, but it is less extensive in the former than in the latter snake. The azygos vein just before it enters the right heart receives a stout branch running up vertically from the parietes and a thinner branch coming from the neck-region. Posteriorly the vein passes backwards, and soon divides into two trunks which are thin. The more dorsal of these runs close to the body-wall and receives twigs from each intercostal space. The upper branch runs in close connection, or rather contact, with the lung, for it does not appear to receive any branches from that viscus. After the termination on the parietes of the lower branch of the azygos, this upper branch bends down and supplies, or rather receives, blood from the intercostal spaces some way down the body, though not so far as the region of the hepatic parietal vessels, which will be dealt with immediately. It takes up blood from the next intercostal space to that which furnishes the last branch to the lower of the main branches of the azygos. There is thus no break in the circulation of this region of the body.

Vessels of Neck.—Although the facts concerning the vessels of the neck have been made known by Jacquart, I may take this opportunity of pointing out that in their disposition there is an obvious difference from the corresponding vessels of *Eunectes*. In the latter snake all the four typical vessels are present *, viz., two running along the trachea, and two anterior vertebrals; whereas in *Python* (at least in *P. sebæ*) there are only three of these main venous trunks present, the left vertebral being absent. There is also a disproportion between the two tracheal or jugular trunks, the left being very much smaller in *Python*. I did not observe such a difference in *Eunectes*. This series of facts shows that it is not possible to place the two genera of Boidæ in ascending relations to each other in respect of the venous system; for while *Eunectes* is more primitive in the arrangement of the main veins of the neck, this genus is less primitive in the fact that the anterior abdominal has only one posterior connection with the veins of the posterior region of the body, whereas both are present in *Python*.

Hepatic Portal Veins.—These veins are constituted in *Python sebæ* upon the plan which is to be found in *Eunectes* and *Eryx*. In all of these genera the parietal system (*i. e.* longitudinal veins running along the parietes and collecting the blood from the several intercostal branches before rendering it up to the liver circulation) is much developed. There are, however, differences in the way in which this system is formed in these various Boine

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* Only three are figured by Gadow in *Boa madagascariensis* (loc. cit. pl. cxxxv.).

Snakes. I have already dealt with *Eryx*[*] and *Eunectes*[†]. I do not find that Jacquart's illustrations conform absolutely to my own observations; but it may be, of course, that this system shows some variations. I find that, as in other Boidæ, the system of longitudinal parietal vessels is chiefly developed upon the left side of the body, but not so exclusively so in *Python* as in *Eunectes*. The left parietal vessel commences posteriorly at about the end of the lung, that is to say very considerably behind the liver. Anteriorly it ends at about the level of the bifurcation of the aorta into its right and left moieties.

Between these two points the vessel is almost, if not absolutely, continuous. It receives the intercostals as they emerge from the parietes, and sends off branches to the liver and to the alimentary canal in this region. These branches are at least partly independent of each other; that is, separate branches pass to each viscus or perhaps rather from one to the other. The veins which pass to the liver enter the anterior extension of the portal vein lying upon the liver, and there are at any rate nine of them. Anteriorly the longitudinal parietal ends in a bifurcation, and behind this there is another branch, which, like one half of the anterior bifurcation, lies upon the right side of the body, distributing its branches to the intercostal spaces of that side of the body. In *Eunectes*, although the left longitudinal parietal vessel is the only one developed, it receives twigs from both sides of the body, but there is no development of a longitudinal trunk or trunks upon the right side. As in other Snakes, a particularly strong branch from the longitudinal parietal passes up to the portal trunk just before the latter reaches the liver.

The main points in the foregoing notes upon the veins of *Python sebæ* to which I desire to call attention are the following:—

(1) The double origin of the anterior abdominal vein, one root from each renal afferent vein, as in *Eryx jaculus* and in the Lacertilia without exception.

(2) The prolongation of the renal afferent vein beyond the kidney along the sperm-duct, this region being, like the renal afferent, a persistent posterior cardinal.

(3) The existence of a trace of the umbilical vein, which persists in its entirety in *Eunectes*.

(4) The paired main trunks of the neck distinguish *Eunectes* from *Python*, where, as has been also shown by others, there are only three trunks and the paired jugulars are not symmetrical in size.

(3) *Some Notes upon* Ilysia scytale.

The following notes are the result of the examination of a single specimen of *Ilysia scytale* which has been in my possession for some time.

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[*] P. Z. S. 1904, vol. ii. p. 118.

[†] Above, p. 24.

It measures 19¾ inches in length.

The base of the heart lies 4½ inches from the tip of the snout. The liver, which is 7 inches long, commences just at the heart as in Vipers. The gall-bladder lies 14 inches behind the tip of the snout. The kidneys are elongated, and not particularly shortened as in *Eryx*. The right kidney, 23 mm. long, ends 21 mm. in front of cloaca. The left kidney, 21 mm. long, ends 11 mm. in front of cloaca. The right testis begins 10 mm. behind the gall-bladder; the left testis begins 9 mm. behind end of right testis.

The *lung* of *Ilysia* is single*, and the vascular part, which is of considerable thickness, extends for a considerable way down the liver, being some 2¼ inches in length. The windpipe, as is usual, is formed of incomplete rings, a fibrous fold connecting them along its entire length. Just before the trachea opens into the lung there is a minute orifice which represents the 2nd bronchus; but there is no approximation to an equality between the two bronchi such as exists in the Boine snakes. The end of the trachea, that is, of course, of the only functional bronchus, extends some little way into the lung before it disappears. This disappearance is not quite abrupt; the rings of the bronchus cease just before the end to be circular, transversely-arranged cartilages; they anastomose with each other, and finally assume a honeycomb disposition, precisely like the lining-membrane of the ensuing lung. Still the bronchial region can be distinguished from the pulmonary by its bluish colour.

Alimentary Canal.—The condition of preservation of the specimen which I have dissected, and the comparatively empty alimentary canal, render it possible to give an accurate account of the rugæ and plications of the different regions, which is not always so easy. There are, moreover, obvious differences between *Ilysia* and some other snakes, both in the structure and proportions of the several regions of the alimentary tube. The *œsophagus* extends to the posterior end of the liver, where it more or less suddenly passes into the stomach. Internally the demarcation is quite abrupt. It is shown, in fact, by the different nature of the folds of mucous membrane which line the two sections of the anterior part of the alimentary canal. The stomach in its anterior part is lined by three, and three only, thick longitudinally-running folds. At the junction of stomach and œsophagus these thick folds disappear as such, and are either nearly or quite continuous, with at least six similar but much smaller folds. There is thus a perfectly obvious demarcation between œsophagus and stomach. The stomach itself is 56 mm. (or about 2 inches) long, and is plainly divisible into two regions: the first of these is much the larger and measures 48 mm.; the second is about coextensive with the gall-bladder, which is attached to it and measures 8 mm. The larger anterior region of the stomach is, as already mentioned, traversed by three thick folds, which show here and there an interesting trace of a reticular arrangement. There are occasional short branches of the folds, which, although they do not reach another fold, indicate an approach towards, or a reminiscence of, a reticular arrangement. Towards the posterior end of the anterior part of the stomach the folds lose their importance and smaller folds between them appear. But the whole series of folds dies out upon a cushion-like elevation. Then follows the shorter posterior region of the stomach, which is entirely free from rugæ of any kind. The small intestine is short as compared with that of some other serpents. Not counting its windings, it measures in a straight line from the end of the stomach to the beginning of the large intestine 51 mm., or 2 inches. About half of this consists of a closely-folded section, which commences immediately after the circular valve separating the stomach from the intestine. Then follows a straight section, which just before its opening into the dilated commencement of the large intestine bends once or twice abruptly upon itself, thus constituting another shorter coiled region. The intestine is lined with fine wavy folds. The large intestine is also 51 mm. in length to the anus.

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* As Mr. Butler (P. Z. S. 1895, p. 704) and others have noted.

Vascular System.—Though it is impossible to elucidate the arrangement of the vascular trunks in a spirit-preserved specimen in a thorough fashion, I have nevertheless been able to ascertain certain facts which are of importance from a systematic point of view. I have been able to follow the abdominal branches of the aorta, and find that the first hepatic branches are disposed as follows:—The *first branch* which arises supplies the *stomach*, and reaches that organ at about its middle. On a level with the gall-bladder a *second equally stout branch* is given off which divides into two trunks: one of these runs forward and is gastric; the other has a posterior course and is intestinal. The next branch of the aorta is *that of the right testis*; it is of course very slender. I did not discover the corresponding branch to the other testis. The next artery to arise is the *right renal*, which enters the kidney near to its anterior end. A *rectal artery* comes next and is followed by the *left renal*, which is also the only artery of this kidney and enters it near to its anterior end. Then follow *three rectal arteries.*

Intercostal Arteries.—In the arrangement of these arteries *Ilysia* plainly shows its affinities to the Boidæ. In the last-mentioned family * the intercostal arteries are paired structures, which is not the case with, at any rate, many Colubridæ and Viperidæ. In *Ilysia* the same paired structure is plainly visible; furthermore, it is to be noted that the intercostal arteries are regular in their arrangement—that is, that they supply the intercostal spaces continuously, a pair of arteries corresponding to each vertebra. This is, of course, also a Boine character. It is important also to note that the intercostal arteries arise from the aorta as single trunks and bifurcate later. The arrangement of these arteries, in fact, is precisely as in *Python*, as figured by Jacquart.

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* Jacquart, Ann. Sci. Nat. (4) iv.; and Beddard, P. Z. S. 1904, vol. i. p. 338, & P. Z. S. 1904, vol. ii. p. 108.

Among the Lacertilia it is very general, if not universal, for the mesenteries to contain muscular strands, which in the case of the dorsal mesentery arise from the vertebral musculature and are often inserted on to viscera. These bands of muscle are made up in all cases where they have been examined of unstriped fibres. I find in *Ilysia* a structure which is to be regarded as the equivalent of these bands of muscle in the Lacertilia. This consists of a single band of fibres of about the same calibre as one of the larger arteries—for which indeed, or for a vein, I at first mistook it. The nacreous glitter, however, of the strand shows its muscular nature, which appearance was confirmed by microscopic examination. The fibres of which it is composed are plain fibres. This band of muscle arises from the centra of two vertebræ by strands from each near to the posterior end of the liver. It runs obliquely forwards, and ends in an attachment to the upper surface of the liver. It avoids the alimentary canal, passing to the right of that tube. The existence of only this one straight band of fibres of unvarying calibre throughout is different in detail from what is found among the Lacertilia.

From this necessarily imperfect survey of the anatomy of *Ilysia*, it is possible to abstract two characters in which this genus, placed in a Family of its own, resembles the Boidæ, and one other in which it departs from the structure of that group.

Ilysia agrees with the Boidæ in the following points:—

(1) In the regularity and paired character of the intercostal arteries.

(2) In the fact that each kidney is supplied by a single renal artery.

On the other hand, *Ilysia* differs from the Boidæ (excepting *Ungalia**) chiefly in the fact that the lungs are not normal paired structures but that one is rudimentary.

The other features which I have been able to note in this survey of certain points in the anatomy of this genus are, in the present state of our knowledge, indecisive of the affinities of the genus.

(4) *The Structure of the Young* Bitis nasicornis, *with Notes on other Vipers.*

A considerable number of young Vipers of this species were born in the Gardens in November last, some of which were alive, whilst some had been born dead. I examined several of the latter. The young snakes were enveloped in the amnion, and the other fœtal membranes were in much the same condition as in the case of the newly-born *Eunectes notæus* described above. The "navel" (text-fig. 8) is, however, in this Viper much smaller than in the Anaconda. The actual patch of skin uncovered by scales only occupied the extent of two of the ventral scales, which were here divided into two. On either side a small number of the ventral scales were divided in the middle line, but there was no interval between the two halves of each scale. Moreover, only two scales anterior to the navel and four behind it were thus divided. The conditions, therefore, are distinctly different from those obtaining in *Eunectes*. Furthermore, the position of the navel differs. In *Bitis* only 10–14 scales intervened between the navel and the cloacal orifice: the actual distance was 14 mm., the whole snake measuring some 9¾ inches*. The embryonic veins were apparent, as in *Eunectes*. The umbilical vein can easily be traced from the "navel" to the vena cava inferior, which it enters towards the anterior extremity of the liver. As in *Eunectes*, this vein has no relation whatsoever to the anterior abdominal vein that I could discover. It has, however, an obvious connection with the epigastric vein, which leads me to introduce the matter here, not as a contribution to the anatomy of the Vipers, but as explanatory of the anatomical facts which I have just referred to in the Python†. Close to the union of the umbilical vein with the vena cava a branch ascends from the epigastric to join the umbilical. This seems to me to be a fact supporting the inference which I have put forward

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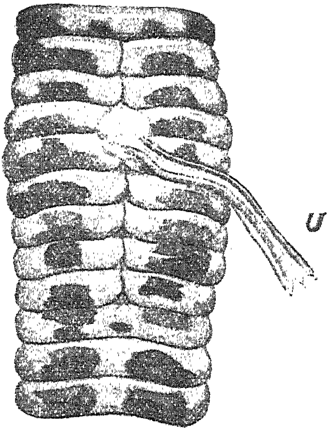
* See Cope, "On the Lungs of the Ophidia," Proc. Amer. Phil. Soc. xxiii. 1894, p. 220.

Text-fig. 8.



Region of umbilicus in newly-born *Bitis nasicornis*.
U. Umbilical sac.

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* In *Vipera berus* also the navel is close to the cloacal aperture

† Above, p. 29.

as to the partial persistence in the adult Python of the embryonic umbilical vein.

Trachea and Lung.—In this Viper the tracheal lung is not in any way marked off from the ensuing thoraco-abdominal portion of the lung. The latter extends as an efficient respiratory organ for some distance down the liver. The tracheal or bronchial gutter ends at a level with about the middle of the heart. There is no trace of a second lung. It is necessary to emphasise these various facts, since they differ among the Viperidæ. The total absence of a second rudimentary lung in this species has been already noted by Butler*. In addition to the species which he mentions, I may note here that *Lachesis gramineus* has a rudimentary left lung. In *Ancistrodon piscivorus* the lung is vascular for about an inch behind the heart, and the tracheal gutter is continued for about the same distance, being thus more extensive than in *Bitis nasicornis*. In *Lachesis gramineus* the vascular part of the lung is less extensive posteriorly. *Causus rhombeatus* differs in some respects from these other Vipers. Like all other Solenoglypha, it possesses the tracheal lung; but it differs from some other Vipers in the fact that the tracheal section of the lung is the only part which is vascular, the rest being anangious. The trachea is continued down the lung from the very beginning of the tracheal lung as a gutter down to near the end of the liver.

Intercostal Arteries.—In dealing with certain facts concerning the vascular system in *Lachesis gramineus* †, I pointed out that, contrary to what is to be found in many Snakes, the intercostal arteries perforate the body-wall accurately in the middle line and singly. This feature, I am now inclined to believe, is distinctive of the Viperidæ, for I have since found a similar state of affairs in *Causus rhombeatus* and *Ancistrodon piscivorus*.

Veins and Arteries of Lung.—Dr. Gadow, in a figure ‡ of the pulmonary arteries and vein of *Crotalus*, represents these vessels as passing forward from the heart. This direction is of course in conformity with the tracheal lung of that snake, where possibly the respiratory organ lies entirely in front of the heart. In the young *Bitis* both artery and vein bifurcate. The artery bifurcates some little way after its origin, and the anterior branch supplies the tracheal lung, while the posterior branch supplies that portion of the lung which lies behind the heart. The pulmonary vein shows the same general distribution. There were two main branches, one anterior and one posterior. The direction of emergence from or of entry into the heart, as the case may be, was rather lateral than definitely anterior or posterior. I deal on a later page § with these facts with reference to the original form of the lung in the Squamate reptiles.

Veins of Neck (text-fig. 9, p. 38).—Contrary to what is to be found in many Snakes, there are only two main veins of the neck in *Bitis*

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* P. Z. S. 1895, p. 705.

† P. Z. S. 1904, vol. i. p. 366.

‡ In Bronn's Thierreich, Rept. Bd. vi. Abth. iii. Taf. cxxxvi. fig. 2.

§ Below, p. 41.

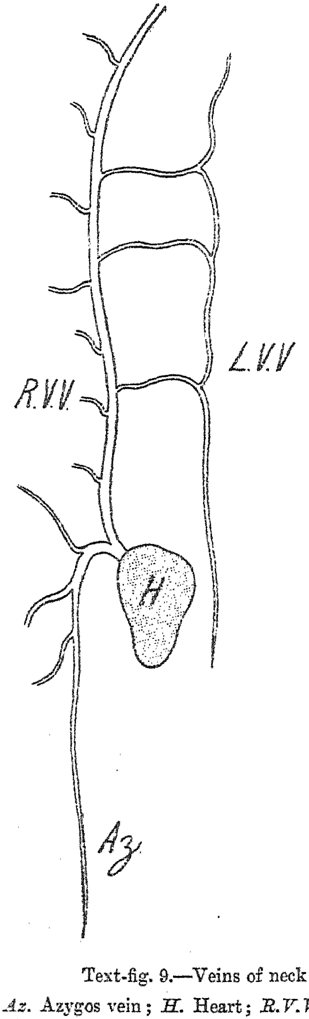
nasicornis. Each of these two is closely accompanied by an artery. The larger enters the heart in common with the azygos, and runs forward on the right side of the body as far as the head. It is much more slender in its most anterior region than near the heart. This vein gives off to the right a series (I counted seven in the most fully developed specimen) of branches to the parietes, which immediately plunge into the thickness of the body-wall after a very short free course. From the left arise a smaller number of veins which have a longer course. Of these I found not more than three. They arise at right angles from the main trunk, and cross the body to the left side of the dorsal median line. Here they appear to become continuous with a longitudinal trunk which runs a considerable way towards the head and posteriorly as far as a little way down the liver. This vein runs much further from the dorsal middle line than the right jugular and the right azygos. The branches, soon after leaving the jugular, send off a twig to the œsophagus.

The longitudinal vein of the left side of the body, supplied by branches from the right jugular, represents, as I imagine, the left anterior cardinal, the right vein being the persistent right anterior cardinal. Their mutual asymmetry with reference to the median lines of the body is remarkable. It is possibly to be accounted for by the pressure exerted by the trachea and lung pushing the vein further away from the middle line. The right azygos vein appears at first sight to be of less extent than a more careful examination shows it to be. In three of the specimens which I examined this vein, which is of considerable calibre, appeared to end at about the level of the ventricular apex; but in a fourth example it was distinctly continued back by a very slender prolongation to a point quite on a level with the middle of the liver. It is noteworthy that the azygos not only gives off branches to the intercostal spaces along which it runs, but that close to its origin—or rather debouchement into the auricle—it sends out a forwardly-running branch, which ought, so to speak, have been furnished by the anterior cardinal of that side of the body.

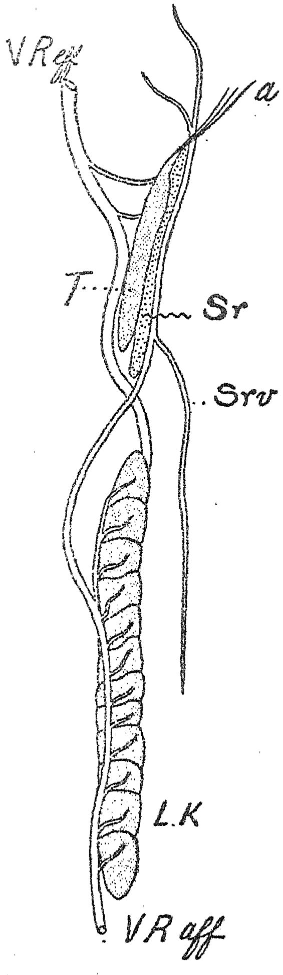
In addition to the right jugular, which is a vessel as thick as any in the body, and the rudimentary left jugular, which is practically a branch of it, though morphologically, as I imagine, a distinct vein, an internal jugular runs along the trachea. This vein, like the right jugular or anterior cardinal, is closely accompanied by an artery. The artery, however, like the vein, is thinner than are the pair which run along the body-wall on the right side. Whether there is a corresponding and less developed vein for the opposite side of the trachea, I am unable to say.

In the arrangement of these anterior veins *Bitis* stands at the opposite pole from the Anaconda, whose anterior veins have been considered above. In the latter serpent all four veins, viz. both anterior cardinals and two internal jugulars, exist. In the Viper the reduction is striking. Intermediate conditions are offered by *Boa*, in which, according to Gadow's figures, the veins of the neck are three. This reduction is in consonance with the generally received opinion as to the much modified character of the Viperidæ as compared with other Serpents.

Text-fig. 9.



Text-fig. 10.



Text-fig. 9.—Veins of neck of newly-born *Bitis nasicornis*.

Az. Azygos vein; *H.* Heart; *R.V.V.*, *L.V.V.* Right and left vertebral veins.

Text-fig. 10.—Veins in region of kidney of newly-born *Bitis nasicornis*.

a. Anterior termination of testis in a fibrous band; *L.K.* Left kidney. *Sr.v.* Suprarenal portal vein; *Sr.* Suprarenal body; *T.* Testis; *V.R.aff.* Afferent renal; *V.R.eff.* Efferent renal.

Veins of Kidney, Suprarenal Bodies, and adjacent region.—The kidneys measure from 29 mm. to 32 mm. in length, and are divided into about 20 lobules. The afferent renal vein extends to within 3 mm. or so of the anterior end of the kidney, giving off a branch between each lobule. In one specimen, at any rate, the renal afferent vein gives rise to a large branch (see text-fig. 10, p. 38) which leaves the surface of the kidney some way before its anterior end, so that the rest of the renal afferent anterior to this point of origin appears to be a branch of this, the main trunk. This vessel is clearly a persistent posterior cardinal, which runs forward in close contiguity to the suprarenal gland. It extends beyond this gland and ends in two branches to the parietes. These latter seem to me to be the afferent suprarenal veins. There is furthermore another afferent suprarenal vein, which also joins the cardinal, but towards the posterior end of the suprarenal body. This vein collects blood from the lateral parietes, and runs parallel with the kidney. Whether it does or does not communicate with the afferent renal behind the kidney, I do not know. In another specimen this vein was quite as well or even better developed; but it was continued directly into the vein running along the suprarenal body, which I have presumed to be the posterior cardinal vein of this side of the body. There was no connection, that I could ascertain, with the afferent renal.

The suprarenal veins are very conspicuous and two in number; they run from the anterior part of the suprarenal body over the testis, and open into the efferent renal vein.

It will be seen that the vein which runs along the parietes beside the kidney is precisely that of *Eunectes* described above*; but in *Bitis* I have not been able to ascertain the presence of a posterior connection with the afferent renal. It is, furthermore, plainly to be compared with the vein occupying a similar situation in *Chamæleo*, which has been described by Hochstetter† and myself‡, and which I have figured §.

Hepatic Veins.—So many of the observations upon the veins of Reptiles have been made upon a single example, that it is not always certain how far the appearances described represent the normal. I am therefore careful here to describe the course of the veins in all of the specimens of this Viper that I have had the opportunity of studying. The result is to show that the variations are not very great (so far, of course, as the small number of examples allows of such a statement), and that therefore the arrangement of these veins at any rate is of use for systematic purposes. The portal vein (text-fig. 11, p. 40) offers no remarkable features. It reaches the liver at the junction of right and left lobes, as in other Serpents; and from that point until the anterior end of the liver it runs superficially, receiving branches from both the dorsal and ventral parietes. Of the dorsal parieto-hepatic veins, one is absolutely constant throughout the whole series of individuals. This vein reaches the portal shortly after it has reached the liver, collects blood from several intercostal spaces, and runs back to nearly the level of the posterior end of the liver. It is apparently generally present in the Ophidia and is not merely a characteristic vein of the Vipers.

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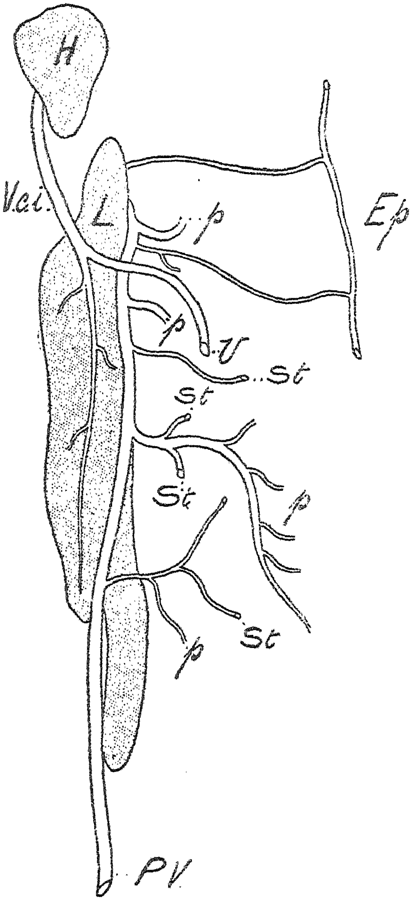
* p. 22.

† Morph. Jahrb. xix. p. 462.

‡ P. Z. S. 1904, vol. ii. p. 8.

§ *Loc. cit.* fig. 1 A, p. 8.

Text-fig. 11.



Portal veins of newly-born *Bitis nasicornis*.

Ep. Epigastric; *H.* Heart; *L.* Liver; *p.* Parieto-hepatic veins, two of which receive branches from stomach (*St.*), represented as cut off at the end; *P.V.* Portal vein; *U.* Umbilical vein; *V.c.i.* Vena cava posterior.

This vein received, in the most fully-developed specimen which I examined, two veins from the stomach. There were in this example three other veins of the same kind, of which two received branches from the gut; there was also an independent gastro-hepatic vessel, as is shown in the accompanying figure (text-fig. 11, p. 40), which represents the liver-veins of this example. The epigastric vein sends, at any rate, two branches to the liver, which are very anterior in position: one of these receives a branch from the stomach before entering the liver. In another example there were only three dorsal parieto-hepatics. It was in this example that a branch from the epigastric joined the umbilical vein, as referred to above. In a third specimen, I saw only two parieto-hepatic vessels, arising, as in the others, from the left side of the dorsal median line. In this and other cases the differences may not be real, but due to absence of blood in the vessels at the time of examination.

The origin of the hinder mesenteric vein in the Ophidia has been variously stated, the different modes of origin described possibly corresponding to the different species and genera examined. Hochstetter* describes and figures *Tropidonotus natrix* (with which he finds *Coluber æsculapii* to agree) as possessing a mesenteric vein which arises from both afferent renals, the two branches combining to form the single vein. I have not been able to ascertain to my satisfaction the arrangement of these veins in *Bitis nasicornis*; but in another Viper, *Ancistrodon piscivorus*, I have found that each renal afferent vein gives off a branch, and that these join to form the mesenteric vein running along the lower surface of the large intestine. The arrangement characteristic of this Viper is therefore precisely that of *Tropidonotus* and *Coluber*.

(5) *Considerations respecting the Primitive Structure of the Lungs in the Squamata.*

Hatteria (or, indeed, most Lacertilians) on the one hand, and such a snake as *Causus rhombeatus* on the other, represent the two extremes of modification of the Squamate lung. In the former the lungs are paired and equal, and are effective breathing-organs throughout: they are separated from the glottis by a long stretch of trachea, and by two equisized bronchi into which the trachea divides some way in front of the lungs. In the Viper, on the other hand, the trachea opens into the lung but a short way behind the glottis, down which it is continued as an open gutter; at, or about, the level of the heart the lung becomes anangious and is a mere air-sac; while there is no trace of a second lung, or of a division of the tracheal gutter into two bronchial tubes. It is undoubtedly the prevalent opinion that of these two extremes, that represented by *Hatteria* is near to the primitive Sauropsidan lung, while the lung of *Causus* represents the most modified type. Paradoxical though it will appear, there are reasons founded upon anatomical facts which necessitate a reconsideration of this view, and which tend to destroy its apparent obviousness.

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* Morph. Jahrb. xix. 1893, p. 489, pl. xvi. fig. 19.

Cope*, to whom our knowledge of the headwards extension of the lung is mainly due, though the fact of this extension in the Viper was known fifty or sixty years earlier, terms this section of the lung the "tracheal lung," and after a survey of the leading groups of Ophidians found it to occur in the principal subdivisions of the order or suborder. He found this tracheal lung in *Ungalia* among the Boidæ, "in the Solenoglypha without exception," and in several Colubrines, to which I myself have added the Hamadryad †. The occurrence of these tracheal lungs so widely among the Ophidia suggests a retention of a character rather than its independent development in the several groups. So far, however, one can do no more than incline to the former view. There are, however, other facts. In the first place, among Snakes generally the rings of the trachea, where there is no tracheal lung, are incomplete posteriorly, leaving a gap filled in with soft tissue. This soft tissue is continuous with the lung-tissue where the latter commences, in these cases near to the heart.

It might be held—if the matter ended here—that the non-junction of the tracheal rings posteriorly had no more significance than the failure to join posteriorly of the tracheal rings in the Cassowary ‡ or in Man §. But a few cases seem to show that this failure to join is of meaning as the last term in a series. For in some Serpents, *e. g.* in *Lioheterodon*, there is not merely a failure to unite posteriorly among the tracheal rings, but the membranous space left is of wide dimensions, much wider than the actual trachea, and fully as wide as the tracheal lung where that organ is developed. Moreover, in this snake there are traces of a development of diverticula of the cavity such as are to be met with in a much more fully developed condition in the Hamadryad snake ||. These facts therefore afford some evidence that the tracheal lung was formerly more widely spread among the Ophidia than it is now; that it is not a new structure in those forms where it occurs, but an archaic structure so far, at any rate, as Snakes are concerned.

It will be observed, moreover, that there is a distinct relation between the development of the neck part of the lung and the asymmetry of the lungs. This relationship, however, does not after all amount to a great deal; for the only Serpents in which there are a pair of well-developed thoracic lungs are the Boidæ. It is nevertheless noteworthy that among these primitive Snakes, as they are held to be, the genus *Ungalia*, which possesses the tracheal lung, is, like the Colubrine Snakes, without more than a rudiment of one of the lungs. The only allied form in which this asymmetry of the lungs is known to exist is *Ilysia*; but in *Ilysia* there is no development of the tracheal lung. My object,

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* Proc. Amer. Phil. Soc. 1894, p. 217.

† P. Z. S. 1903, vol. ii. p. 319.

‡ Forbes, P. Z. S. 1881, p. 783.

§ Treatises on Human Anatomy.

|| Beddard, P. Z. S. 1903, vol. ii. p. 319.

however, being rather anatomical than physiological, this mode of compensation—as it may be considered to be—will be left aside. For it is, I think, impossible to hold, in the present state of our knowledge at any rate, that the unpaired condition of the lung is the primitive one for Snakes, and that the minute rudiment of the second lung in many Vipers and Colubrines is an incipium of a second lung. Still the question does not appear to me to be absolutely settled, for reasons which I hope to investigate more fully later.

But although it may be said that there is some evidence that among the Ophidia the existence of a tracheal lung is not an innovation but an inheritance, the case would seem at first sight to be quite different among the Lacertilia. If the assumption that the Lacertilia form one order with the Ophidia, and the theory which I seek to prove concerning the origin of the lungs in the Squamata be probable, there should be evidence of a positive kind among the Lacertilia of the existence of traces of a tracheal lung. The most positive piece of evidence is that furnished by Prof. Wiedersheim, who has described in *Amphisbæna fuliginosa* what appears to be a persistent tracheal lung [*], the existence of which, however, has not been confirmed for other species [†]. It is noteworthy, too, that in various Lizards the tracheal rings are far from meeting posteriorly; in *Lacerta*, for instance, there is a very wide membranous interval posteriorly, at the edge of which only appear the tips of the tracheal rings. Furthermore, in many Lizards—this is particularly well seen in *Varanus*—the lung extends forward a good way beyond the entrance of the bronchi into the lung. The arrangement in such a lizard as *Varanus* is quite reminiscent of the disposition of that organ to be seen in *Heterodon platyrrhinos*, where the tracheal lung is not traversed by a tracheal gutter, but extends forward along the intact trachea as a continuation forwards of the thoracic lung.

Were it not for the numerous cases of a tracheal lung attached to the trachea throughout, this condition in *Heterodon* would probably have been compared merely with the slight forward extension of the lung in many Lacertilians, in which the bronchus enters at the side rather than at the base of the lung. Such a comparison would indeed be correct, but it would not be so far-reaching as I believe there are grounds for regarding it [‡]. Besides, this incomplete comparison of facts, as I regard it, would leave it an open question as to whether the lungs in the Squamata were not derivable from the type shown in *Hatteria*, and to which a forward extension had been afterwards added. As it is, there are further facts which enforce the position taken up by me in this communication. I have pointed out, in describing the pulmonary artery and vein of *Bitis nasicornis*[*], that both artery and vein bifurcate soon after leaving, or just before entering, the heart. One branch goes to, or comes from, the anterior tracheal part of the lung, while the other branch has a similar relation to the thoracic part of the continuous lung. It seems to me that this anatomical fact explains two other facts which have been a little difficult to me hitherto.

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[*] 'Lehrbuch der vergleichenden Anatomie der Wirbelthiere.'

[†] Beddard on *Amphisbæna*, P. Z. S. 1905, vol. ii. p. 489.

[‡] This statement of course assumes the validity of Prof. Cope's view that the headward extension of the lung in *Heterodon* is the homologue of the tracheal lung in, *e. g.*, the Viperidæ.

The trachea in Snakes, and in certain Lizards at any rate, is closely accompanied by arteries or an artery which is one of the systemic branches. This carotid artery is concerned with the blood-supply of the windpipe and adjacent organs and regions. In some cases, however (probably much more generally than I am at present in a position to know), the trachea is accompanied by arteries which arise *not* from the systemic arteries but from the pulmonary. I have shown this to be the case in *Gerrhosaurus*[†] and more recently in *Hatteria*[‡]. In both of these Saurians the artery in question is most clearly a branch of the pulmonary, and equally clearly lies alongside of the windpipe anteriorly. A careless dissection would fail to show this, as I consider it, highly important point. It is, however, plain when the artery is properly followed out in an injected specimen.

Now the pulmonary artery is, it is hardly necessary to say, a respiratory artery: it is concerned, that is to say, not with the nutritive supply of the lung-tissue but with the oxygenation of the blood. The tissues of the lung receive their nutritive supply from elsewhere. Branches from the aorta supply this need which have no relation whatever to the special respiratory arteries and veins. This is, of course, universally true of the higher vertebrates. It seems therefore that the persistence of a branch of the pulmonary artery supplying the trachea, taken in conjunction with the bifurcating pulmonary artery of the Viper with its tracheal and thoracic portions of the lung, is a fact which decidedly points in the direction of a previous respiratory function of that part of the respiratory passage which it now supplies.

The assumption upon the various facts which have been briefly dealt with in the course of the preceding remarks, that the most primitive type of Squamate lung is most nearly preserved in certain Serpents, is recommended by certain general considerations.

Whatever may be the views as to the phylogeny of the Squamata, it can hardly be disallowed that Reptiles generally have emerged from an Amphibian or Dipnoan form. On this view, the commencement of the lung far forward in the body is intelligible, for the earliest condition known, that represented in the Dipnoi, shows a lung at first (or always, *Ceratodus*) unpaired communicating directly with the exterior through the glottis and mouth-cavity.

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[*] Above p. 36.

[†] "On the Anatomy of the Yellow-throated Lizard," P. Z. S. 1904, vol. ii. p. 263, text-fig. 37.

[‡] "On the Vascular System of *Hatteria* &c.," P. Z. S. 1905, vol. ii. p. 462.

3. On the Minute Structure of the Teeth of Creodonts, with especial reference to their suggested resemblance to Marsupials. By CHARLES S. TOMES, M.A., F.R.S., Vice-Pres.Z.S.

[Received January 15, 1906.]

(Text-figures 12–25.)

That the Creodonts, though obviously not Marsupials, nevertheless present resemblances to them has been noted by many observers. Filhol (1) has discussed the question, and Matthew (2) uses the expression "pseudo-marsupial characters of the Mesonychidæ," while he also says of *Pachyæna* that "in its dentition this species approximates the Marsupial dental formula." Lydekker (3) goes a little further, and says "these and other fossil forms, such as *Borhyæna*, seem to indicate an intimate relationship between the Polyprotodont Marsupials and the Creodont Carnivores represented by *Hyænodon*." Wortman (4) also speaks explicitly upon the same point; whilst frequently alluding to marsupial resemblances in their osteology and dentitions, he says: "By taking the more primitive members of the existing marsupials as the basis of our comparisons, I am convinced we shall be able to arrive at a very much clearer understanding of what the ancestors of the Creodonts were like"; and "Present evidence points to the fact that the two groups of the Creodonts probably arose side by side from Mesozoic Marsupials," and further "that they were derivatives or offshoots of any pre-existing group of Placentals is exceedingly unlikely."

Such speculations being rife, it occurred to me that it would be interesting to ascertain what evidences of affinity the minute structure of their teeth might afford, and by the kindness of Dr. Matthew, of the American Museum of Natural History, I have been enabled to make sections of the teeth of a number of representative species of Creodonts, whilst Dr. Smith Woodward has kindly furnished me with a fragment of a premolar of *Borhyæna*.

But, before detailing the results of an examination of these teeth, it seems desirable to say a few words upon the nature and value of the evidence to be derived from the histological structure of teeth, the more so because this line of investigation has been but partially pursued and its results appear to be not well known to the majority of naturalists.

It might have been expected that there would be but little variety of structure in the teeth of animals belonging to the same great groups, for it is not easy to see how this should be affected by the ordinary processes of selection. It might have been thought that so long as a tooth was strong enough, sharp enough, and well adapted in external form to its work, its structure would matter little and would remain constant. But it was shown by my father, the late Sir John Tomes (5), that by a mere examination of sections of the enamel it was possible in the case of Rodents not merely to pronounce that the enamel was that of a Rodent, but in a large number of instances to refer it correctly to a particular family of Rodents, or to a group of families.

In the more simple forms of enamel, the enamel prisms all pass outwards from the surface of the dentine to the outer surface of the enamel, and are, with very slight exception, exactly parallel with one another.

But in the Rodents contiguous layers of enamel prisms start off from the dentine at different angles, the layers alternating in this respect, so that if the section embraces in its thickness more than one layer, as such sections almost invariably do, patterns are produced by the crossing of the prisms, and these patterns are constant and characteristic of many of the families.

Similarly, my father showed that the enamel of Marsupials (6) presented characters very unusual in Placental mammals, and therefore almost characteristic of Marsupials, whilst the Carnivora also presented well-marked enamel characteristics.

It therefore seemed to be well worth while, in view of the uncertainty of the position of the Creodonts and of their relation to recent Carnivora, and possibly to the Marsupials, to apply this test of their affinities.

As bearing upon the subject generally, I may mention that I myself examined the teeth of a number of genera of the Gadidæ (7), a family selected as being both fairly numerous and at the same time compact, with the result that I found that the enamel was alike in all, but that the dentine presented marked variations upon a common type of vasodentine, and that these peculiarities coincided with their zoological arrangement, and not with the functional development of the dentition. Thus some of the largest teeth presented the simplest, and almost degraded, structure common to them and their immediate relations, whilst some teeth, reduced so as to be almost rudimentary, retained the complexity of structure characteristic of their zoological relations. These, however, are the only papers I have met with in which this line of research had been followed out to any extent.

In what may be termed the normal arrangement of the dental tissues of placental mammals, the tubes of the dentine end by branching and becoming very fine, or by entering minute globular or angular spaces within the boundaries of the dentine (see text-figs. 15, 16, & 19, pp. 50, 51, 53); but it was shown by my father that in Marsupials the greater number of the dentinal tubes, instead of so ending, became continuous with tubes which traverse the enamel. This is true of all Marsupials, recent or extinct, which were examined by him or by myself at later dates, with the solitary exception of the Wombat, in which this does not happen, though, as might be expected from what has already been said, the precise extent to which it happens and the patterns produced vary in different families of the Marsupials.

Were there no more than this to be said, we should be provided with a criterion of marsupial affinity both certain and easy of application. But unfortunately the case cannot be fully stated quite so simply. Whilst it remains quite true that all marsupial enamels present this character of penetration by the dentinal tubes, the converse is not quite true. Thus *Hyrax* has an enamel so richly penetrated by dentinal tubes that it might be easily taken to be a marsupial enamel, though in this respect it stands quite alone among placental mammals. But traces of this peculiarity are to be found in much reduced degree in certain Insectivora, notably in the Shrews; this occurrence in Insectivora may possibly be interpreted as a survival from some marsupial form of ancestor. But this explanation is not available for all cases: in very reduced degree the character has been found in the Jerboa, in some Carnivora, and even in Man, though in Man the rarity of the occurrence and its irregularity when it does occur suggest that it is pathological, or at least that it is a reversion towards something which has disappeared long ago. And investigations of my own (8) into the development of enamel, and especially of marsupial enamel, distinctly point to this penetration of the epiblastic enamel by tubes continuous with those of the mesoblastic dentine being a primitive character, to which some slight tendency to revert has not been quite lost by placental mammals.

Hence, in the interpretation of the occurrence of this character a different value appears to attach to negative and positive results: if we find no tubes at all in the enamel, we shall, I think, be quite justified in saying that no near affinity with the Marsupials can exist. On the other hand, if we find rudimentary traces of this penetration, we shall not be justified in attaching great importance to it as an evidence of marsupial affinity, though if we find an abundant penetration we shall have a character which, so far as is known, is peculiar to Marsupials and to *Hyrax*.

Having thus cleared the ground as to the value of the evidence, it remains to describe in slightly greater detail what is met with in the Marsupials, in Carnivora, and in Creodonts.

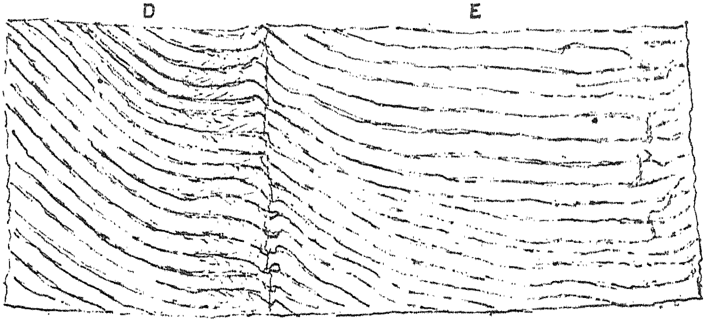
MARSUPIAL ENAMEL.

A general character of marsupial enamels is the simplicity of the course pursued by the enamel prisms; each prism pursues, as a rule, an almost straight course from the dentine to the enamel surface, and where marked curvatures do occur, all of the contiguous prisms pursue the same curve, so that no patterns are produced by neighbouring prisms crossing one another. Where, however, the tubes are very abundant, the enamel prisms can hardly be seen at all, and we have to take the tubes as indicative of their course.

The enamel is most richly tubular in the Diprotodont group; though it must not be thought that the tubes are sparse in the Polyprotodonts. In a large number of instances there is a slight dilatation at the point of junction of the dentinal tube with the enamel tube, a sort of clumsy joint in fact (text-fig. 12); but this is not an invariable character, the tube sometimes passing on with no mark at the point of junction. Where, however, the enamel thins out towards the neck of the tooth, the tubes in it, whether it be that of a Diprotodont or a Polyprotodont, become few or none, so that it is necessary to be careful not to select the enamel to be examined from this situation.

As illustrations of typical marsupial enamels I have selected that of *Hypsiprymnus* (text-fig. 12), of *Thylacinus* (text-fig. 13, p. 49), and of *Dasyurus* (text-fig. 14, p. 49); those interested in the subject will find figures from other genera in the paper of my father's already referred to. With regard to these and the other figures illustrating this paper, I may say that for the sake of clearness they are semi-diagrammatic. Though all have been drawn from actual sections, fewer tubes have been drawn than actually exist in a given area, and all indications of structure, other than those with which we are immediately concerned, have been left out.

Text-fig. 12.



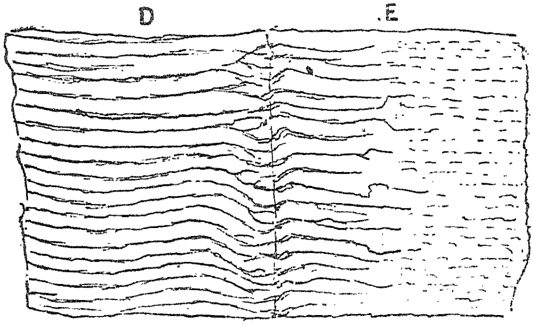
All the figures, though drawn from actual slides, are semi-diagrammatic.

Hypsiprymnus.—Longitudinal section of dentine (D) and enamel (E). The tubes in the enamel reach its outer surface, or nearly reach it. Slight dilatations mark the passage from the dentine to the enamel.

In the Diprotodont *Hypsiprymnus* (text-fig. 12) the enamel tubes are seen in their greatest development. Starting, usually with a dilatation at that point, from the dentinal tubes they traverse the entire thickness of the enamel, turning a little to one side as they approach its periphery, and some of them branching off almost at right angles. It must, however, be understood that had the section been taken from the thin enamel near the neck of the tooth, fewer tubes, and finally no tubes at all, would have been seen. Where the tubes are very abundant, as in this case, it is difficult to see the outline of the enamel prisms, which, however, where traceable pursue a nearly straight course.

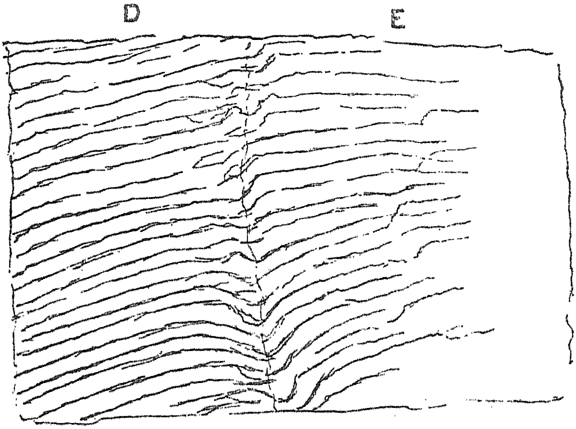
When, however, we come to the enamel of *Thylacinus* (text-fig. 13), we find that the tubes thin out and are lost before they reach the exterior of the enamel, even where this is thickest, though sections may be found in which they penetrate further than in that figured. And where there is a tolerably abundant passage of tubes, the so-called granular layer, which marks the exterior of Placental dentines (*cf.* text-fig. 15, p. 50), is absent or but little conspicuous. Outside the region of the tubes the enamel prisms are fairly distinct and are seen to be straight; the straight prisms may also be traced by careful illumination right in to the

Text-fig. 13.



Thylacinus.—Longitudinal section of dentine and enamel. The tubes reach halfway through the enamel.

Text-fig. 14.



Dasyurus.—Longitudinal section of dentine and enamel.

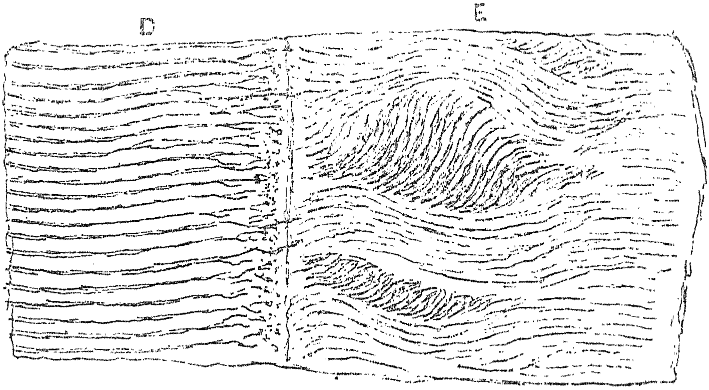
dentine surface. Towards the neck of the tooth enamel without tubes is, as in the Diprotodonts, to be found.

Dasyurus enamel resembles that of *Thylacinus* pretty closely, though the tubes generally reach further through the enamel (text-fig. 14, p. 49).

THE ENAMEL OF CARNIVORA.

As an illustration I have selected that of the Hyæna (text-figs. 15 & 16), though it may be premised that the enamel patterns of Carnivora are fairly constant. As one would expect from analogy, they are not quite identical in all: thus in the Dog group they are simpler, and where the enamel is thin the prisms become quite straight. Where, however, the enamel is thicker, the patterns are easily identifiable as similar to those found in, for example, the Felidæ, though the curvatures are less pronounced.

Text-fig. 15.

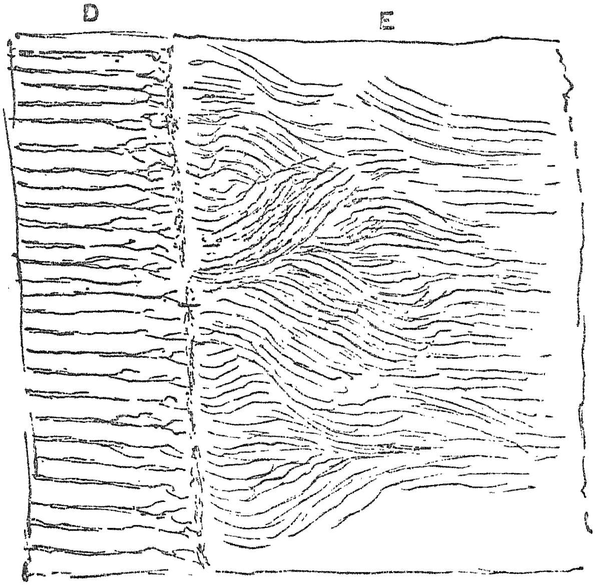


Hyæna.—Longitudinal section near apex of cusp. A few dentinal tubes pass a little way into the enamel. Most of the dentinal tubes branch and terminate in the minute spaces of the granular layer. The enamel prisms are arranged in alternating bundles, and pass nearly at right angles to one another.

Two figures are given to show the difference in pattern when the enamel is viewed in a longitudinal and in a transverse section of the tooth; hence any obliquity in the plane of the section will alter the appearances. But, after a little experience, it is not difficult to discriminate between differences due to differences of plane and those due to real differences in arrangement.

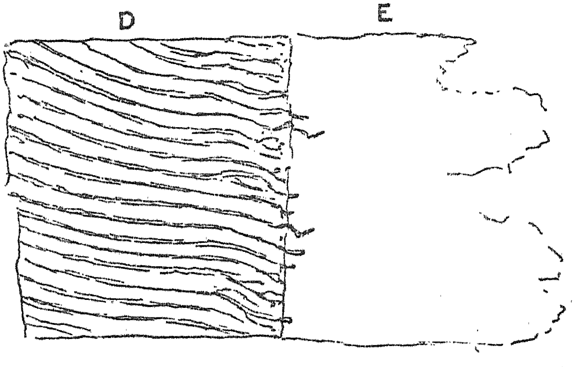
It will be noticed that no prisms in this, the thicker portion of the enamel, pursue a straight course, and that all do not pursue the same course. They are, however, grouped into bundles or sheaves of prisms pursuing an approximately parallel course, whilst towards the exterior of the enamel all the bundles become parallel and straight. They are thus interwoven with one another in a way that is not found in any known marsupial.

Text-fig. 16.



Hyæna.—Transverse section.

Text-fig. 17.



Ocelot.—The enamel prisms are not shown, but some dentinal tubes pass a little way into the enamel.

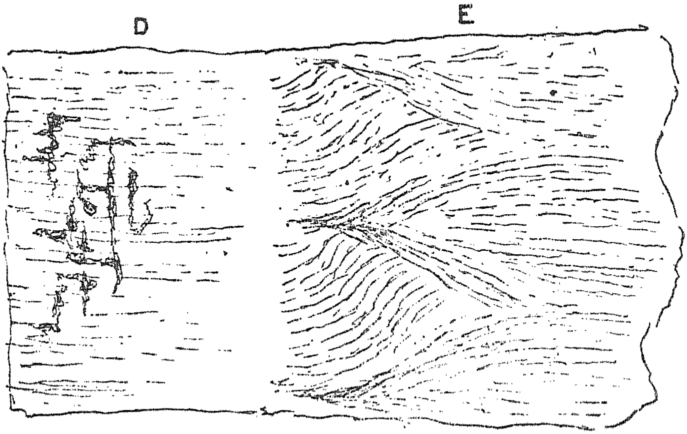
As regards the other character, namely, that of the enamel being penetrated by tubes running in from the dentine, none are seen to do so in text-fig. 16; in text-fig. 15 one or two penetrate a very little way.

In text-fig. 17, the enamel of an Ocelot, I have drawn an example of a greater penetration of the enamel by dentine tubes: this, I may say, is the section which shows this to the greatest extent out of some sixty sections taken from different genera of Carnivora. But though, on the whole, this slight rudimentary degree of penetration is perhaps rather more frequent in Carnivora than in most mammalian orders, in none does it occur to an extent in the least comparable with that found in Marsupials.

The Enamel of Creodonts.

The examination of fossil teeth presents greater difficulties than that of recent teeth. Structurally, the enamel is always well preserved, but it has in the process of mineralisation often become unduly transparent, so that careful illumination is even more essential in deciphering its structure. And the teeth are often exceedingly brittle and friable, so that it is difficult to get good sections; this can be partly overcome by imbedding the teeth in desiccated Canada balsam before grinding them down. The dentine, however, being richer in organic matter, is often very badly preserved, so that sometimes all structure has disappeared; a fact which handicaps the observer in tracing the passage of tubes from it, and sometimes leaves him only able to look for characteristic appearances of tubes in the enamel itself. Moreover, many of the teeth being rare, only small bits or

Text-fig. 18.



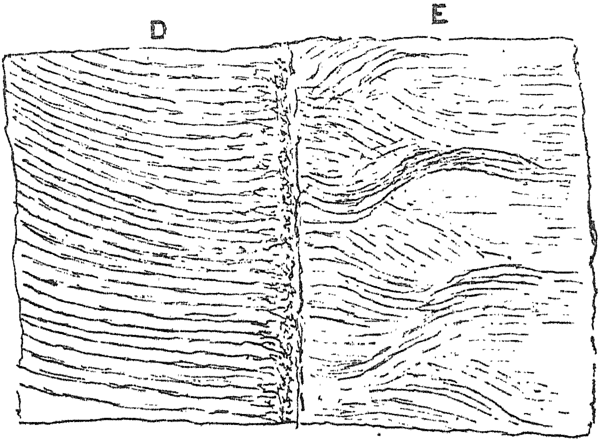
Hyænodon.—Transverse section. The enamel prisms are arranged in bundles radiating so as to present a goblet form. In the dentine, not very well preserved, the excavations of a fungus are seen.

damaged teeth were available for examination, so that it was not always possible to select the plane in which a section was most desirable: one had to take what one could get.

Still, if the enamel of a fossil Diprotodont be examined, there is no difficulty in seeing the enamel tubes and being absolutely sure of their existence and their course, and the direction of the enamel prisms can always be traced in a fossil enamel.

The first figure (text-fig. 18) represents the enamel of *Hyænodon* (Oligocene of S. Dakota): in it no trace of penetration by tubes can be found, and the very distinct enamel pattern is closely similar to that found in a recent Carnivore (*cf.* text-figs. 15 & 16). In passing I may call attention to the curious spaces, dark in the figure, found in the dentine, which are quite common in the dentine of fossil teeth. In recent teeth they are only known to occur in teeth which have been lying about in a graveyard, or in others which have been lying at or near the surface of the ground. They are excavations caused by a boring fungus; it is generally believed to be one of the mould fungi and is perhaps *Saccharomyces mycoderma.* As it does not seem likely that even the hungriest of mould fungi could find much pabulum in a fossilised tooth, this boring presumably took place when the tooth was comparatively fresh, and thus points to the persistence of this mould fungus from Oligocene and Eocene periods.

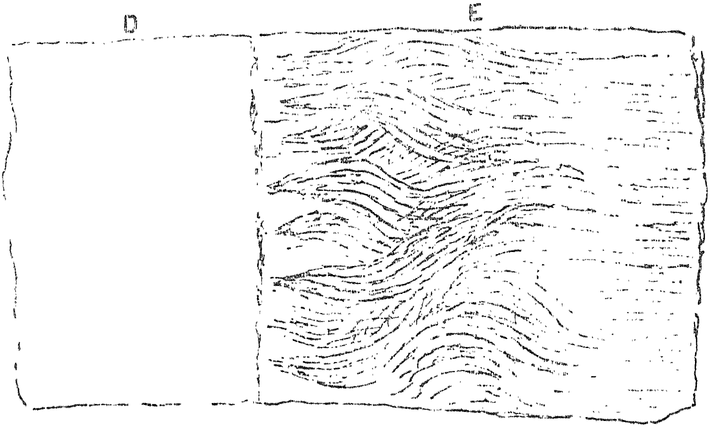
Text-fig. 19.



Mesonyx.—Longitudinal section. No tubes penetrate the enamel: there is a well-marked granular layer, the dentine being well preserved.

Mesonyx (Middle Eocene) (text-fig. 19).—In this specimen the structures are well preserved. Not only are there no notable enamel tubes, but the outer periphery of the dentine presents appearances inconsistent with penetration of the enamel: namely, the dentinal tubes fine down, or spread into tiny branches, and there is a well-defined granular layer. The course of the enamel prisms is similar to that seen in *Hyænodon* and in recent Carnivora.

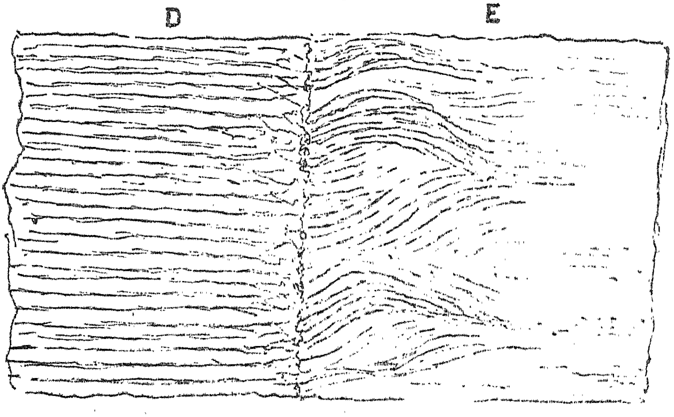
Text-fig. 20.



Pachyæna.—Dentine perished. The enamel prisms are arranged in bundles like *Hyænodon*, but the plane of the section is not quite the same.

Pachyæna (Lower Eocene) (text-fig. 20).—The dentine structure is gone, but the enamel prisms are very distinct, no tubes are seen in it, and the prisms are gathered into bundles pursuing a course similar to that seen in *Hyænodon* or in *Hyæna*.

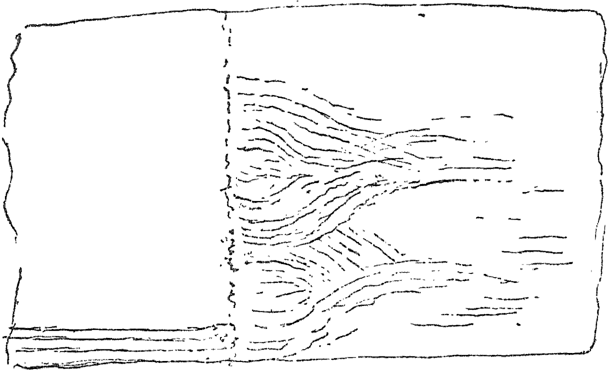
Text-fig. 21.



Oxyæna.—Dentine well preserved.

Oxyæna (Lower Eocene) (text-fig. 21).—Here again similar conditions obtain, though the section not being in exactly the same plane, the course of the prisms appears to differ a little. But this is a difference purely due to a difference of plane, and not to a real difference of course.

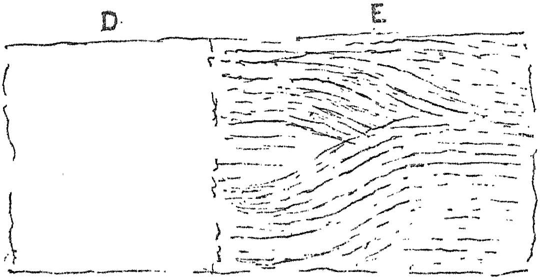
Text-fig. 22.



Sinopa.—Dentine perished, except in places.

Sinopa (Middle Eocene) (text-fig. 22).—Here again we get just the same pattern, and the same absence of penetrating tubes.

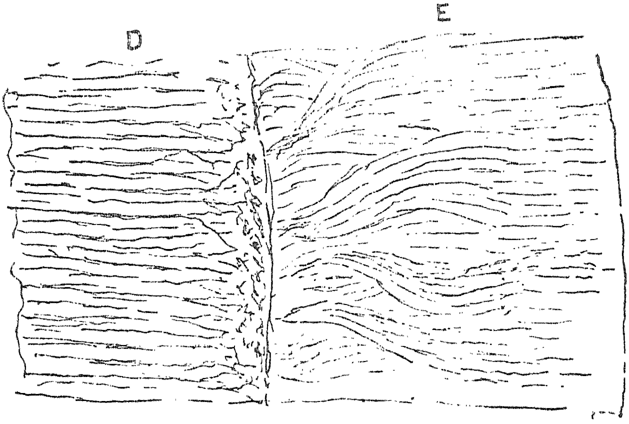
Text-fig. 23.



Borhyæna.—Dentine perished, enamel well preserved.

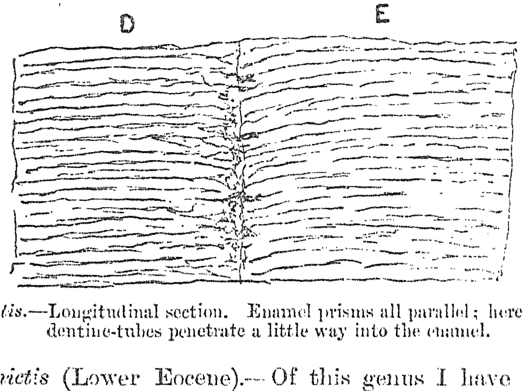
Borhyæna (text-figs. 23, 24).—In this genus we find the absence of penetrating tubes, and can distinctly recognise the carnivorous pattern in the course of the prisms. But apparently the prisms are a little straighter than in recent Carnivora, or at least in recent Felidæ. It is not, however, possible to speak very positively as to this greater simplicity, as I had only a fragment of a tooth at my disposal, and the sections I was able to get were small and may not have included any of the thickest parts of the enamel, where, as has already been noted, these characters are to be found most marked. However, there is ample evidence to say that the enamel of *Borhyæna* is essentially of the Carnivorous type, and bears no more resemblance to that of the Marsupials than does that of other Creodonts.

Text-fig. 24.



Borhyæna.—Dentine well preserved in places. The plane of this section is not quite the same as fig. 23, but only fragments having been available it is not possible to define the plane in which the section lay.

Text-fig. 25.



Cynodictis.—Longitudinal section. Enamel prisms all parallel; here and there dentine-tubes penetrate a little way into the enamel.

Didymictis (Lower Eocene).—Of this genus I have only two sections, but in them the enamel prisms are all parallel and pursue a course only slightly curved. The typical carnivorous pattern is not to be found, nor is there any trace of it, so that of the Creodonts examined this and *Cynodictis* stand alone in this respect. Portions of enamel might be found resembling this in the teeth of the Dog, if taken towards somewhat low down upon the tooth, but the enamel is in the two sections I have obtained tolerably thick, and might have been expected to show more complexity of structure if any such exists anywhere upon the tooth.

Cynodictis (Oligocene) (text-fig. 25).—A specimen of this genus was sent to me by Dr. Matthew as an example of an early true Carnivore. In it the enamel prisms are almost straight and no decussation, or only the faintest trace of decussation, of the prisms of different planes is to be seen. It resembles chiefly the enamel of *Didymictis*, and differs in respect of its greater simplicity from that of the other Creodonts examined and from recent Carnivora. My section of *Cynodictis* embraces the whole tooth, so that there is no question as to greater complexity of pattern existing in any other parts of the tooth. In some of the Creodont enamels, and particularly in *Cynodictis*, slight indications of a rudimentary penetration of the enamel by dentinal tubes are seen, but in none does it exceed or even attain to the amount seen occasionally in recent Carnivora (*cf.* text-fig. 17, p. 51).

CONCLUSIONS.

The nature and the limitations of the evidences of affinity which can be derived from a study of the minute structure of teeth have already been alluded to, and it must not be forgotten that it is unsafe to build too much upon any one single character.

But, so far as the structure of their enamel may be taken as evidence, neither *Borhyæna*, *Pachyæna*, *Hyænodon*, *Sinopa*, *Mesonyx*, *Oxyæna*, *Didymictis*, nor *Cynodictis* presents any greater resemblance to Marsupials than do the recent Carnivora. On the other hand, with the exception of *Didymictis* and *Cynodictis*, the enamel has reached just that stage of evolution found in the true Carnivora, and the enamel patterns are strikingly similar to those of recent Carnivora.

The uniformity of the patterns found in all of the Creodonts examined, excepting again *Didymictis* and *Cynodictis*, seems to point to the structure of their enamel having attained to a sort of finality; that is to say, it was probably not undergoing any rapid evolutionary changes, a conclusion borne out by its close resemblance to that of their descendants, the recent Carnivora.

The absence of the peculiar stamp of the marsupial, the tubular enamel, would justify us in saying that they certainly do not stand very near to any marsupial, and that if there be a marsupial ancestor, or an ancestor common to the Marsupials and to the Creodonts, it must be sought considerably further back than any of those examined. This is a somewhat disappointing conclusion: when I undertook the investigation I quite expected to find some distinct indication of marsupial relationship; that is to say, I expected to find that the general resemblance in macroscopic character of the dentitions to those of the polyprotodont Marsupials would have been accompanied by histological resemblances.

I have also been surprised to find that the enamels of *Didymictis* and of *Cynodictis* are actually simpler than those of the other Creodonts, and simpler than most recent Carnivora. As *Cynodictis* at all events appears to be nearer to the true Carnivora than are the Creodonts, the simplicity of its enamel as compared with theirs may point to its not lying on quite the same line of descent.

Though I would not attach too much importance to it, I would again call attention to the fact already mentioned, that in Carnivora, and still more so in Insectivora, rudiments of a penetration of the enamel by dentinal tubes occur with more frequency than in other mammals. This may possibly indicate some remote connection with the Marsupials, but the point which I wish to emphasise is that, as regards this character, the Creodonts carry us absolutely no further than do the recent Carnivora.

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4. Synopsis of the Toads of the Genus *Nectophryne* B. & P., with special Remarks on some known Species and Description of a new Species from German East Africa. By Dr. Jean Roux, Curator in the Basle Museum of Natural History.

[Received December 11, 1905.]

(Plate II.*)

On visiting, last spring, the beautiful collections of the Museums of Paris and London, I had occasion to examine, especially in the British Museum, most of the typical specimens of the known species of the genus *Nectophryne*. Whilst verifying the diagnoses, I was able to make some observations modifying or completing

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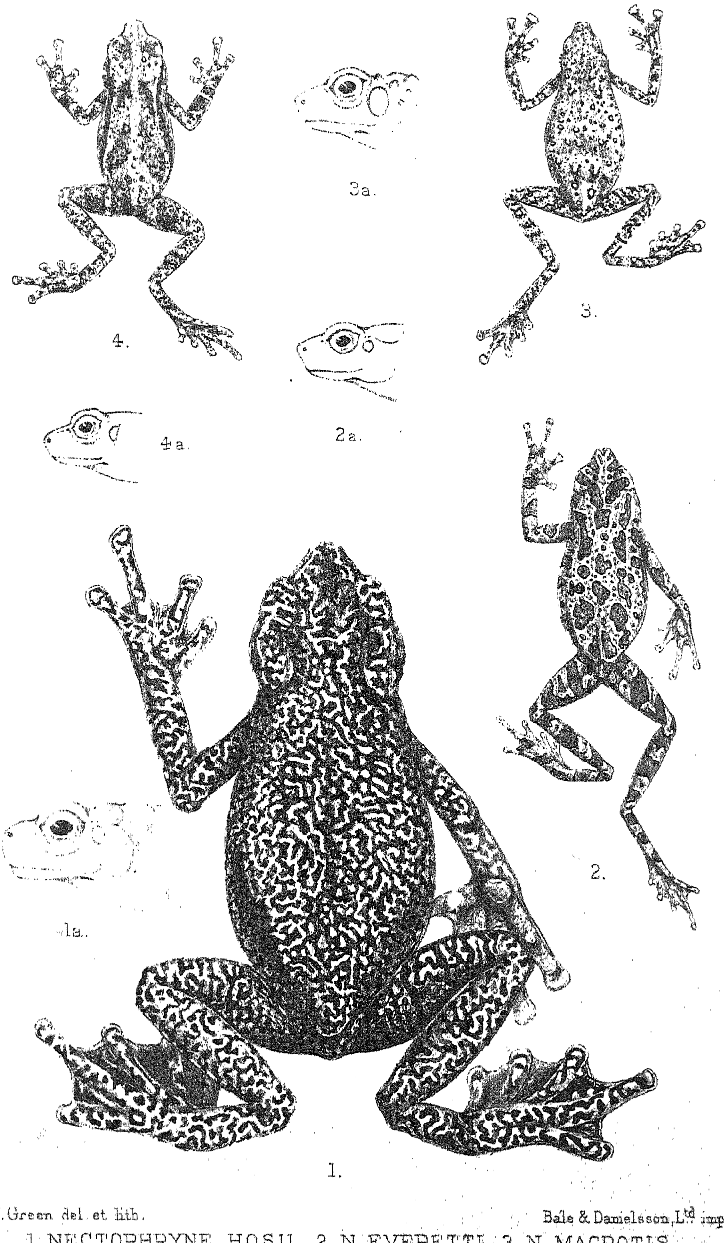
[*] For explanation of the Plate, see p. 65.



J. Green del. et lith. Bale & Danielsson, L^td imp.

1. NECTOPHRYNE HOSII. 2. N. EVERETTI. 3. N. MACROTIS.
4. N. TORNIERI.

somewhat the descriptions of the authors. I was able to identify as one species two that had previously been considered different.

I add to these observations the description of a new species from German East Africa, the type of which is preserved in the Basle Museum, and conclude this paper with a key for the determination of all the known species of the genus.

I am happy on this occasion to express my best thanks to Dr. Mocquard, of Paris, who was so kind as to allow me to examine the types of the species described by him. I am also much obliged to Prof. Boettger, of Frankfort a/M., and to Prof. Tornier, of Berlin. The former has been kind enough to send to me the type of his *N. exigua* which is preserved in the Senckenberg Museum; to the latter I am indebted for the loan of the types of two species in the Berlin Museum. I am particularly indebted to Mr. G. A. Boulenger, who has obligingly placed at my disposal the valuable collection in the British Museum (Natural History), and has been so kind as to verify the work done in his laboratory.

1. NECTOPHRYNE AFRA B. & P.

Buchh. & Peters, Mon. Berl. Akad. 1875, p. 202, pl. ii. f. 5.
Boulenger, Cat. of Batrach. Sal. p. 279.

Examined: The type specimen (Berlin Museum): Cameroon.
6 specimens (Brit. Mus.): Efulen, S. Cameroon, and Rio Benito.

This species occupies quite a special place as regards its webbed fingers, the subarticular tubercles of which imitate small lamellæ.

2. NECTOPHRYNE MISERA Mocq.

Mocquard, Le Naturaliste, 1890, no. 82, p. 182; Nouv. Arch. Muséum Paris, sér. 3, tom. ii. p. 161, pl. xi. f. 7.

Examined in Paris Museum: Type specimen, N. Borneo.

In Brit. Mus.: 10 specimens from Paka-Paka, 10,000 feet, Kina-Balu, N. Borneo.

This species has also strongly webbed fingers, but no subarticular tubercles. Sometimes the tibio-tarsal articulation does not quite reach the tympanum.

3. NECTOPHRYNE HOSII Blgr. (Plate II. fig. 1.)

Boulenger, Proc. Zool. Soc. Lond. 1892, p. 508, pl. xxx. fig. 2.

Examined in Brit. Mus.:—

Type specimen (♂).	Mt. Dulit, N. Borneo.
2 specimens (♂ ♀).	Kuala Lumpur, Selangor.
2 ♂.	Lawas, Brunei.
1 ♂.	Head-waters of Sarawak R.
1 ♂, 2 ♀.	Sarawak.
1 ♀.	Tandjong, S.E. Borneo.
1 ♀.	Akar River, Sarawak.

This is the largest species of the genus. The diagnosis given by Boulenger in 1891 was drawn up from a male specimen from Mt. Dulit, Borneo. Since then the collection of the British Museum has been increased by several specimens, especially females, which I have had the privilege to study. As is often the case with *Bufo*, in this species the female individuals are notably larger than the males. The distinctive characters indicated by Boulenger are generally very well marked in the female. The head is broader in comparison with the length. The canthus rostralis is well marked. The loreal region is nearly vertical and shows a slight depression in the upper part. The interorbital space, twice as broad as the upper eyelid, is very distinctly concave, as well as the part of the head situated near the parotoids. The tympanum is very distinct; it is suboval, vertically elongated, and half as long as the eye. The parotoids are well marked, pyriform, and begin immediately behind the eyes.

As to the limbs, we have noticed individual variations in the length, especially in the hind limbs. The fore limb is relatively long: the fingers, webbed only at the base, are bordered by the membrane, and the distal part is subtriangularly enlarged; this peculiarity is more appreciable in the fingers than in the toes. The hind limbs of most of the individuals observed are longer than in the type specimen. The hind limb being carried forward along the body, the tibio-tarsal articulation reaches sometimes the tympanum, sometimes the eye. The toes are generally short, entirely webbed, except the three distal phalanges of the fourth toe, which are free. The subarticular tubercles are very well developed, as well as the two metatarsal tubercles. The outer tubercle is twice as large as the inner. I have noticed the presence of a very distinct tarsal fold.

The coloration of the individuals is worthy of detailed description owing to the marked differences between males and females.

The type specimen, a male, figured by Boulenger, is uniformly brown with some indistinct spots on the limbs; the throat is black. Two other male specimens show the same coloration, but two male specimens from Lawas, Brunei, are somewhat different. The body shows, besides the dark brown, some light brown markings, which form indistinct coarse vermiculations. The limbs are yellowish brown, and present also lighter and darker parts more or less distributed in transverse bands.

The females labelled "Sarawak," one of which is figured on Pl. II. fig. 1, are distinctly bicolor (yellow and black). The ground is black with small vermiculations or round yellow spots (in the latter case especially on the sides of the body). The head, the back, and the limbs show also these vermiculations. The spots are a little broader on the anterior part and on the sides of the head. The lower part of the body and of the limbs is generally dirty grey or uniform yellowish. The border of the lower lip often shows yellow spots. The inferior part of the feet is brown. The females have generally smaller and less numerous dorsal tubercles than the males. The females from Tandjong (S.E. Borneo) and from Akar River (Sarawak) show the typical coloration above described.

A female specimen from Mt. Kuala Lumpur (Selangor) shows an interesting variation. The general colour is a dark grey, approaching brown. The upper part of the head, of the back, and of the tibia shows no yellow spots, but the sides of the body and of the limbs, as well as the upper part of the thighs, have round or oval spots pretty distant from one another. These spots are of a fine yellow colour, with brown border. Similar but longer spots may be found on the throat and on the anterior part of the chest.

A female from Akar River (Sarawak) shows irregular and indistinctly distributed spots. The yellow colour is prevalent on the back; the sides are marbled yellow and black; the belly is of a dirty yellowish colour.

The following are the dimensions of two individuals from Sarawak found pairing, the female in the act of spawning:—

	♂.	♀.
Length from snout to vent ...	5·65 cm.	9·8 cm.
„ of hind limb	7·65 „	13·7 „
„ „ fore limb	4·3 „	6·9 „

The eggs of *Nectrophyne hosii* are oval, 1 millimetre in length; they are laid in chains as in *Bufo*.

4. NECTOPHRYNE PARVIPALMATA Wern.

Werner, Verhandl. zool.-bot. Gesells. Wien, vol. xlviii. 1898, p. 201, pl. ii. ff. 7 & 7 *a*.

Examined: the type specimen in the Berlin Museum. Habitat: Cameroon?

5. NECTOPHRYNE EVERETTI Blgr. (Plate II. fig. 2.)

Boulenger, Ann. Mag. Nat. Hist. (6) xvii. 1896, p. 450.

Examined in the Brit. Mus.:—

The type specimen (♀): Mt. Kina Balu, N. Borneo.
1 ♂ specimen: Mt. Penrissen, Borneo.

In this second individual the tympanum is quite visible, oval. The hind limb being carried forward along the body, the tibio-tarsal articulation reaches between the tympanum and the eye.

6. NECTOPHRYNE TUBERCULOSA (Gthr.).

Günther (*Pedostibes tuberculosus*), Proc. Zool. Soc. Lond. 1875, p. 576, pl. lxiv. fig. C.

Boulenger, Cat. Batr. Sal. p. 280.

Examined in the Brit. Mus.:—

2 ♂ type specimens: Malabar.

The hind limb being carried forward along the body, the tibio-tarsal articulation reaches the tympanum. The upper part of the limbs is also covered with tubercles.

7. NECTOPHRYNE GUENTHERI Blgr.

Boulenger, Cat. Batr. Sal. p. 280, pl. xviii. fig. 3.

Boettger (*Nectophryne exigua*), Abhandl. Senck. Gesells. 1901, vol. xxv. p. 394.

Examined in Brit. Mus.:—

The type specimen from Matang, Borneo.
2 young specimens } from Singapore.
2 adult ,, }
2 adult ,, from Sirhassen (Natuna Isl.).

Also the type specimen of *Nect. exigua* in the Senckenberg Museum: Baram Riv., N. Borneo.

In this species, as in others, I have also noticed individual variations in the length of the limbs. The hind limb being carried forward along the body, the tibio-tarsal articulation reaches sometimes the eye, sometimes between the latter and the end of the snout. In the typical specimen it does not only reach the eye but notably behind it.

Establishing a comparison between the type of *Nectophryne exigua* Boettger and young individuals of *Nectophryne guentheri*, I have been convinced that these two species are identical.

The differences are indicated by Boettger as follows:

"Habitus etwas weniger schlank; Trommelfell kleiner als bei *N. guentheri* Blgr."

On examining several specimens of *N. guentheri* I have noticed differences not only in the respective length of the body and of the limbs, but also in the respective dimensions of the tympanum and of the eye according to age. The young specimens have proportionally a smaller tympanum than the adults. Besides individual variations have been observed. Some measurements follow:—

	Type spec.	Spec. from Sirhassen.	
Eye	3	1·9	2 mm.
Tympanum	2	1	1·1 ,,

Specimens from Singapore.

Adult.	Adult.	Juv.	Juveniss.
2	1·75	1·9	$\frac{3}{4}$ mm.
1	1·5	1·3	$\frac{1}{8}$,,

A young specimen of *N. guentheri* in particular, which is just as large as the type of *N. exigua*, shows in the general form of the body as well as in the colour a striking likeness to the latter.

Similar black spots are distributed on the belly, and the coloration, yellow and black, on both sides of the head is identical. The limbs show also the same extent of web.

As, on the other hand, it is impossible not to recognise the existing relations between the young specimens of *N. guentheri* with adults of this species, I believe that *N. exigua* may be considered a young specimen of *N. guentheri*. Very appreciable variations having been noticed between several specimens of the latter, the distinction drawn by Boettger between his species and that of Boulenger cannot be accepted.

8. NECTOPHRYNE MACROTIS Blgr. (Plate II. fig. 3.)

Boulenger, Ann. Mag. Nat. Hist. (6) xvi. 1895, p. 171.

Examined in the Brit. Mus. :—

The type specimen (♀) from the Akar River, Borneo.

9. NECTOPHRYNE SIGNATA Blgr.

Boulenger, Proc. Zool. Soc. Lond. 1894, p. 645, pl. xl. fig. 1.

Examined in the Brit. Mus. :—

The type specimen from Rabong Mt., Kapuas Distr., Dutch Borneo.

10. NECTOPHRYNE MACULATA Mocq.

Mocquard, Le Naturaliste, 1890, no. 82, p. 182; Nouv. Arch. Muséum Paris, 3e sér. t. ii. p. 162, pl. xi. fig. 8.

Examined in the Paris Museum :—

3 type specimens from Kina Balu, N. Borneo.

11. NECTOPHRYNE TORNIERI, sp. n. (Plate II. fig. 4.)

Habit slender. Head moderate, as long as broad. Snout short, scarcely prominent, obliquely truncate, quite as long as the eye; canthus rostralis strong. Loreal region vertical, slightly concave in the upper part. Interorbital space broader than the upper eyelid. Tympanum exposed, vertically oval, about one-third the diameter of the eye. The distance between the anterior border of the tympanum and the posterior corner of the eye equal to half the distance between the anterior corner of the latter and the nostril. Fore limb slender, equal in length to the distance between vent and tympanum. Fingers moderate, much depressed, webbed at the base, dilated and truncate at the end, first a little shorter than second. The hind limb being carried forward along the body, the tibio-tarsal articulation reaches the posterior border of the eye. Toes half-webbed, but the three distal phalanges of the fourth toe free. The tips of the toes less strongly dilated than those of the fingers. Subarticular tubercles well marked. Two well-developed metatarsal tubercles, the inner the larger. Skin of the upper part of body and limbs covered with numerous small round warts, irregularly distributed; the largest situated behind the tympanum and on the middle of the back; beneath feebly granulate. The granulations are visible on the posterior part of the belly and on the under part of the thighs, and disappear on the throat.

Brown above, with darker markings, especially two pairs on the back: one between the fore limbs, the other on the sacral region. A large lateral dark band from the eye, surrounding the tympanum, which is lighter in colour, and extending on each side of the body. A dark streak from the end of the snout passing below the canthus rostralis, through the eye, and above the tympanum to the commissure of the mouth. Loreal region brown; a light spot below the eye between yellowish-brown parts of the upper lip. Limbs brownish in colour, with darker markings arranged in indistinct large cross bars. Sides of the body below the dark lateral band lighter than the back, more or less speckled with dark brown. Sometimes a yellowish-brown vertebral stripe extending along the middle of the back, from snout to vent. Beneath entirely white or with a few small dark spots on the throat and belly.

Hab. Ukami, German East Africa. 2 specimens.

Dimensions.—From snout to vent, 27 mm.; hind limb, 38; fore limb, 20; length of head, 9; breadth of head, 9·5.

Named after my colleague, Dr. Tornier of Berlin, who has added much to our knowledge of the herpetological fauna of German East Africa.

The figured specimen of this new species is preserved in the herpetological collection of the Basle Museum, the other has been presented to the British Museum.

If we now consider the geographical distribution of the genus, we notice that most of the species described are from Southern Asia. Borneo is particularly rich. Not less than six species have been found on this island, and one of them has been found also in the Natuna Archipelago (Sirhassen) and Singapore. New discoveries will most likely further extend the geographical distribution of the other species. But we cannot omit to state the fact that up to this date no *Nectophryne* has been discovered, so far as we know, in the other great islands of the Sunda Archipelago.

The genus *Nectophryne* has representatives also in West Africa. The faunal similarity of that district with the south-east of Asia has often been noticed (see Wallace). West Africa possesses two species, and the new species described above shows that the genus is also represented in the eastern part of the African continent.

I conclude with a synoptic table for the determination of the known species of *Nectophryne*, not taking into consideration doubtful species, as e. g. *Nectophryne sundana* (Ptrs.) (Boulenger, Cat. Batr. Sal. p. 281). I have not been able to examine the only existing specimen of this species, which is preserved in the Berlin Museum and comes from Borneo.

Key for the determination of the Species.

I. Fingers strongly webbed, very slightly dilated at the end, the inner quite rudimentary.
  a. Subarticular tubercles present, similar to small lamellæ ... *N. afra.*
  b. Subarticular tubercles absent.. *N. misera.*

II. Fingers partially webbed, more or less dilated at the end, the inner well developed.
  A. Tibio-tarsal articulation not reaching the end of the snout.
    a. Toes only half-webbed.. *N. tornieri.*

b. Toes more than half-webbed.
  1. A tarsal fold .... *N. hosii.*
  2. No tarsal fold.
    α. Tympanum hidden .... *N. parvipalmata.*
    β. Tympanum visible, its diameter less than that of the eye; two metatarsal tubercles.
      * Fingers very slightly webbed at the base, the first equal to ⅔ of the second .... *N. everetti.*
      ** Fingers very distinctly webbed at the base, the first equal to about ½ of the second .... *N. tuberculosa.*
      *** Fingers ⅓ webbed, the web extending as a margin to their tips; the first equal to ½ of the second .... *N. guentheri.*
    γ. Tympanum visible, equal to the diameter of the eye; only one metatarsal tubercle .... *N. macrotis.*
B. Tibio-tarsal articulation reaching at least the end of the snout.
  a. Tympanum visible, equal to ⅔ the diameter of the eye ... *N. signata.*
  b. Tympanum hidden; tibio-tarsal articulation reaching beyond the end of the snout.............................. *N. maculata.*

EXPLANATION OF PLATE II.

Fig. 1. *Nectophryne hosii* Blgr., p. 59, female. ¾ nat. size. 1 *a*. Side view of head.
2. *Nectophryne everetti* Blgr., p. 61, type. Nat. size. 2 *a*. Side view of head, × 1½.
3. *Nectophryne macrotis* Blgr., p. 63, type. Nat. size. 3 *a*. Side view of head, × 2.
4. *Nectophryne tornieri* Roux, p. 63, type. Nat. size. 4 *a*. Side view of head, × 1½.

5. On some Bones of the Lynx from Cales Dale, Derbyshire.

By W. Storrs Fox, M.A., F.Z.S.

[Received October 25, 1905.]

(Text-figure 26.)

Remains of the Lynx have so rarely been found in the British Isles, that the recent discovery of some in a Derbyshire cave will, I hope, be considered to be worth recording. The history of the two former finds may be briefly stated. About the year 1866, the hinder portion of a skull and the right ramus of the lower jaw of this species were discovered in Pleasley Vale, on the borders of Derbyshire and Nottinghamshire, and are now in the Nottingham University Museum. Some fourteen years later a humerus and a metatarsal of the same species were found in Teesdale by the late Mr. James Backhouse, and are still in his son's museum at York.

Thus, until the Cales Dale cave was worked, only four bones of Lynx had been found in the British Islands. I have been unable to obtain any information about the excavation in Cales Dale previous to 1897, but my own find there consists of 36 bones and teeth of Lynx, about half of this number being metapodials and phalanges.

The cave lies on the west side of Cales Dale, a small dale branching from the south side of Lathkil Dale, at a point about half a mile below the source of the river Lathkil. It is 800 ft. above sea-level, and takes the form of a narrow passage, running almost due east and west, in the Carboniferous Limestone. It possesses two entrances. The lower one is almost square in section, measuring 2 feet 8 inches across and 2 feet 9 inches high. By crawling through this, and along a passage of similar dimensions, for a distance of 6½ feet, a dome-shaped chamber is reached 9 feet in height and 4 or 5 feet in diameter. It is into the side of this chamber that the second entrance opens, at about 5 feet above the floor. This second or upper entrance, almost a perfect oval in shape, is 2 feet 10 inches high and 1 foot 8 inches wide.

For the next 18 feet the cave consists of a passage averaging 3 feet high and 3 feet wide; it then widens out into a chamber 6 feet long and nearly 6 feet wide. It was in this chamber that the bones were found. Beyond this chamber the passage rapidly narrows to an impassable fissure.

In March 1894 I was informed that Lynx-bones had been found in the cave; but it was not until the spring of 1897 that I asked and obtained leave to excavate. In the chamber, or den, a thin layer of stalagmite was found. First, all the earth—mixed with bones and stones—lying above the stalagmite was removed; then the layer itself was blasted, and all that had been sealed up by it was cleared away. But, unfortunately, no notes were taken as the work proceeded, so that it is impossible to say now whether any bones were found beneath the stalagmite. As the contents of the cave were dug out, they were carried to a neighbouring spring and were there carefully washed in a one-eighth-inch sieve; and in this way even very small bones were secured.

Both Professor Boyd Dawkins, in his account of the Pleasley * Lynx, and Mr. William Davies, when describing the bones from Teesdale †, used for comparison the skeleton of the Northern Lynx in the British Museum (1230 A). Accordingly, the Cales Dale bones have been compared with the same skeleton.

Of jaw-bones and teeth Cales Dale has produced:—a right ramus of the lower jaw (text-fig. 26 B); the right upper carnassial tooth, imbedded in a fragment of the maxilla (text-fig. 26 A); the right premaxilla containing its three incisors; and three canines. The ramus is incomplete, most of the bone behind the molar tooth being absent; and the upper part of the socket for the canine is

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* 'British Pleistocene Mammalia,' part iii. pp. 172–176 (Palæontographical Society, volume for 1868).

† 'Geological Magazine,' volume for 1880, pp. 346–348.

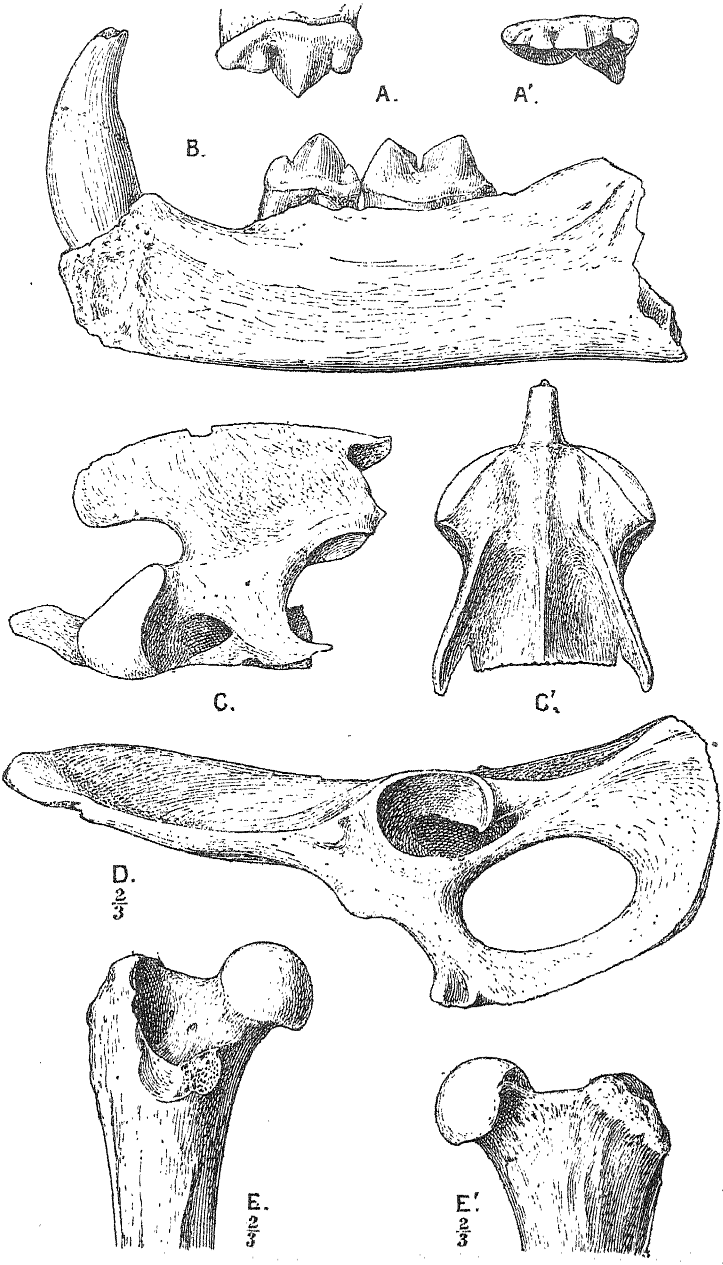
Explanation of Text-fig. 26 (opposite).

Remains of *Felis lynx* from Cales Dale, Derbyshire.

A, A′. Right upper carnassial tooth, outer and lower veiws, p. 68.
B. Right mandibular ramus, inner view, p. 68.
C, C′. Axis vertebra, left lateral and lower veiws, p. 69.
D. Left os innominatum, outer view, p. 70.
E, E′. Proximal end of left femur, posterior and anterior views, p. 70.

A–C, nat. size; D, E, two-thirds nat. size.

Text-fig. 26.



very much worn down. When this bone was found the canine was not *in situ*, but a tooth has been placed in the socket, into which it exactly fitted. The third premolar is missing altogether; and, as the bone has entirely closed over the socket, this tooth must either have been lost some time before the death of the animal, or it could never have existed at all. The fourth premolar, when found, was separate from the jaw, but the molar was in position in the bone.

Taking into consideration the shrinkage caused by the absence of the third premolar, this ramus closely corresponds in general outlines with the Pleasley one described by Professor Dawkins. The following table of measurements, the last two columns of which are taken from 'British Pleistocene Mammalia,' shows this correspondence. The measurements throughout are given in inches and tenths.

The total length of the canine now fixed in the jaw could not be measured; and as the tip is broken off, the original height of the crown must remain uncertain. But the two odd Cales Dale canines are respectively in length: 1·65 ins. and 1·9 ins., whereas the Pleasely specimen is 1·85 ins.; and the height of the crowns of these two Cales Dale teeth is exactly the same as that of the right lower ramus of *Felis lynx* (*borealis*) in the British Museum, namely, ·8 inch, as compared with ·75 inch in the Pleasley animal.

Measurements of right ramus of Lower Jaw.

	F. lynx. Cales Dale.	*F. lynx.* Pleasley.	*F. lynx* (*borealis*). Brit. Mus. 1230 A.
Circumference behind $\overline{\text{M. 1}}$	2·37	2 2	2·0
„ before Pm. 3	*2·14	2·4	2·0
Antero-posterior extent of M. 1	·68	·65	·63
Antero-transverse „ „	·25	·26	·25
Postero-transverse „ „	·26	·24	·23
Height of crown of $\overline{\text{M. 1}}$	·46	·35	·35
Antero-posterior extent of $\overline{\text{Pm. 4}}$	·5	·49	·46
Antero-transverse „ „	·18	·19	·19
Postero-transverse „ „	·27	·27	·23
Height of crown of $\overline{\text{Pm. 4}}$	·34	·35	·35

The measurements of the upper carnassial (text-fig. 26 A) and of the incisors show that there is very little difference between the Cales Dale teeth and those of *F. lynx* (*borealis*).

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* As $\overline{\text{Pm. 3}}$ is lacking in the Cales Dale specimen, the measurement is taken behind the socket of the canine. This absence of Pm. 3 accounts for the relatively small circumference here.

Measurements of Right Upper Carnassial Tooth = Pm. 4.

	F. lynx. Cales Dale.	*F. lynx (borealis).* Brit. Mus. 1230 A.
Antero-posterior extent	·73	·72
Antero-transverse extent	·35	·30
Postero-transverse extent	·22	·23
Height of crown	·39	·41

Measurements of Upper Incisors (imbedded in right premaxilla).

	F. lynx. Cales Dale.	*F. lynx (borealis).* Brit. Mus. 1230 A.
Length of series	·34	·33
Maximum across crown of I. 3	·18	·18
,, back to front of I. 3	·21	·20
Height of crown	·27	·27

There were two portions of bones of the fore limb in this cave, namely, the shaft and distal end of a humerus and the proximal end of an ulna. As the bones of the British Museum skeleton are wired together, it is practically impossible to measure the anconeal fossa of the ulna; but, so far as could be seen, the Cales Dale fragment agrees in form with the corresponding part of the skeleton in question, though it is somewhat larger.

An axis vertebra (text-fig. 26 C) from Cales Dale agrees generally with that of the Northern Lynx (B.M. 1230 A), and only differs to an extent which might be expected in the bone of a rather larger and more powerful animal.

Measurements of Axis Vertebra.

	F. lynx. Cales Dale.	*F. lynx (borealis).* Brit. Mus. 1230 A.
Base of odontoid process to inferior posterior margin	*1·23	1·34
Minimum transversely	·84	·78
Extreme length of neural spine	1·71	1·45

* The inferiority of length here is due to the absence of the epiphysis.

The Cales Dale humerus appears to have belonged to a more powerful animal than *F. lynx* (*borealis*) in the British Museum and the dweller in the Teesdale cave; for in it the deltoid ridge is strongly developed, but is not markedly so in the other two specimens. The supinator ridge is prominent in all three. If the Cales Dale bone had been complete it would have exceeded the Teesdale one in length.

In the following table the last two columns are taken from Mr. Davies's article.

Measurements of Humerus.

	F. lynx. Cales Dale.	*F. lynx.* Teesdale.	*F. lynx* (*borealis*). Brit. Mus. 1230 A.
Transverse diameter of distal end...	1·56	1·40	1·50
„ „ trochlea.....	1·08	·87	1·09
Smallest circumference of shaft......	2·05	1·75	1·75

One nearly perfect left os innominatum (text-fig. 26 D) and a fragment of a right-side one do not appear to have belonged to the same animal, for the fragment seems to belong to a less recent date than the other, and to a larger animal. The bone from the left side lacks only the epiphyses on the extremities of the ilium and ischium. It has the roughened ridge above the acetabulum more pronounced than the corresponding bone of the British Museum skeleton, and is generally rather heavier in build, but in all other respects the two are exactly similar in every detail.

Measurements of Os innominatum.

	F. lynx (left). Cales Dale.	*F. lynx* (right). Cales Dale.	*F. lynx* (*borealis*) Brit. Mus. 1230 A.
Minimum circumference of ilium	2·46	2·71	2·24
Minimum across ilium (from pubic to ischial surface)	·96	1·12	·90
Minimum circumference of ischium (between acetabulum and ischial tuberosity)	1·96	2·05	1·71
Across acetabulum	·79	·81	·81
Maximum length—between extremities of ilium and ischium	*5·90	...	6·18

* The apparent shortness is due to the loss of the epiphyses.

The hind limb is represented by two fragments of femur, namely, the proximal end and part of the shaft of one from the left side (text-fig. 26 E); and the head of another, also from the left side. The larger fragment is perfect except that the lesser trochanter is broken off. It is distinguished from the corresponding bone of the Northern Lynx (B.M. 1230 A) by the greater development of the ridge which travels down the outer side of the shaft from the great trochanter.

Measurements of Left Femur.

	F. lynx. Cales Dale.	*F. lynx.* Cales Dale.	*F. lynx* (*borealis*). Brit. Mus. 1230 A.
Maximum width at proximal end	1·89	...	1·62
„ „ of head	·82	·83	·78
Circumference of shaft, taken 3 ins. from proximal end*	2·12	...	2·0

* In the B.M. specimen this was the minimum circumference.

There are five tarsal bones, including an astragalus and a calcaneum; and also one carpal—which I take to be a pisiform, though it differs somewhat from the pisiform of the Northern Lynx.

Of metapodial bones there are two complete metacarpals, namely, the second of the right and the third of the left manus; one complete metatarsal (mt. 5—left), and another lacking the distal end (mt. 5—right). Besides these there are two fragments, which are specially interesting owing to their size and stoutness of build. A comparison with Mr. Davies's measurements of the Teesdale and British Museum metatarsals is misleading, but is given for what it is worth.

Measurements of Metapodials.

	F. lynx, mc. 2. Cales Dale.	*F. lynx*, mc. 3. Cales Dale.	*F. lynx*, mt. 5. Cales Dale.	*F. lynx*, mt. 5. Cales Dale.	*F. lynx.* Cales Dale.	*F. lynx*, mt. 3. Teesdale.	*F. lynx* (*borealis*). Brit. Mus. 1230 A.
Length	2·75	2·94	3·50	...	...	3·80	4·07
Transverse diameter (proximal end) ...	·58	·47	·47	·52	...	·45	·55
Transverse diameter (distal end)........	·51	·46	·41	...	·54	·48	·52
Least circumference of shaft	·93	·93	·80	·85	...	...	...

The measurements of the phalanges, taken in order of size, are as follows:—

a. First series—proximal ends bifid:
1·65; 1·55; 1·50; 1·25.

b. Second series—distal end on the twist:
1·25; 1·16; 1·08; 1·08; 1·07; 1·03.

There is also a terminal phalanx.

In form these phalanges are similar to those of the corresponding series in the British Museum Lynx. In that skeleton the longest and stoutest phalanx is that which articulates with the third metatarsal bone and measures 1·71 inches; but it is not nearly so stout in build as the Cales Dale phalanx, which is 1·65 inches long. Moreover, the British Museum bone in question is rounded on the under side, whereas the Cales Dale one widens out into ridges at the distal end on the under side.

Measurements of Metapodials of *F. lynx* (*borealis*).
Brit. Mus. 1230 A.

	Left manus.		Left pes.			
	mc. 2.	mc. 3.	mt. 2.	mt. 3.	mt. 4.	mt. 5.
Length	2·7	3·0	3·7	4·08	4·1	3·7
Transverse diameter (proximal end) ..	·55	·45	·4	·52	·3	·31
Transverse diameter (distal end)...... ...	·42	·43	·5	·5	·44	·41
Least circumference of shaft	·8	·8	·92	1·03	·95	·72

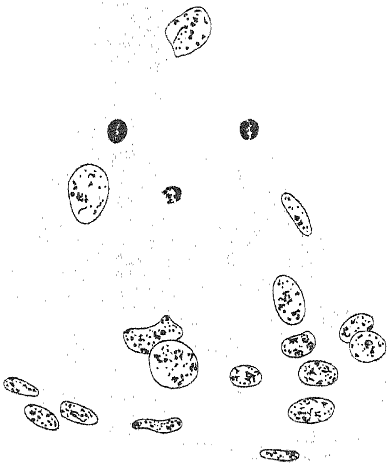
In the British Museum skeleton the longest phalanx of the manus is that which articulates with the third metacarpal, and it measures 1·62 inches.

The other mammalian bones found with those enumerated above throw no fresh light upon the question of the period at which the Lynx lived in this country. They include Wild Cat, Fox, and another species of *Canis* (probably Wolf), Badger, Hare, Rabbit, Water-Vole, Bank-Vole, Sheep, Goat, and Ox. Wild Cat is represented by a fragment of the left ramus of the mandible, containing the third and fourth premolars and the first molar.

Mr. E. T. Newton, F.R.S., kindly identified the bird and amphibian bones, which are as follows:—small Domestic Fowl (or possibly Pheasant), small Grouse, Raven, Jackdaw, Kestrel, Common Gull, Toad, and Frog.

Among the unidentified bones is the premaxilla of a fœtal carnivore, and a number of phalanges of a very young or fœtal animal.

In conclusion, I desire to thank Dr. C. W. Andrews for the practical advice and help which he has given with regard to the identification of the mammalian bones. And my thanks are also due to Mr. Newton for the assistance given by him, as already mentioned.



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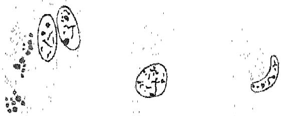

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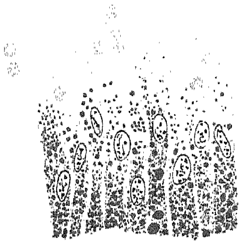

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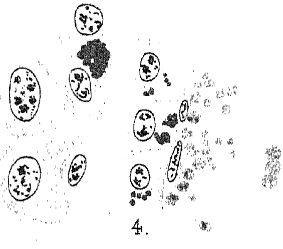

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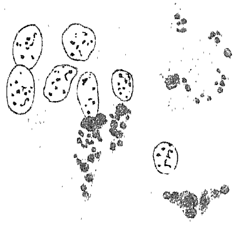

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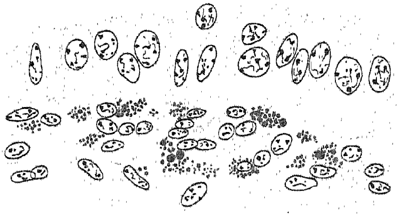

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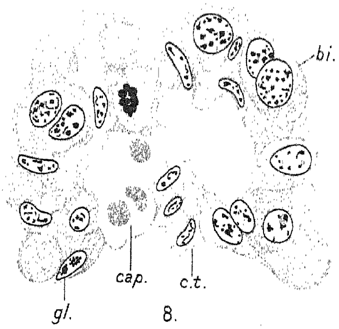

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J. W. Jenkinson del.

Bale & Danielsson, Ltd lith.

HISTOLOGY OF THE PLACENTA OF THE COW AND SHEEP

February 6, 1906.

G. A. Boulenger, Esq., F.R.S., Vice-President,
in the Chair.

Mr. Frederick Gillett, F.Z.S., exhibited a case of mounted cubs of the Timber-Wolf (*Canis occidentalis*) which he had obtained in the Province of Keewatin, Canada. He remarked that this wolf though abundant in that district seldom showed itself, being seen only occasionally in the winter and scarcely ever in the summer.

Dr. C. W. Andrews, F.Z.S., exhibited and made remarks upon some restored models of the skulls and mandibles of *Mœritherium* and *Palæomastodon*. The models were prepared by Mr. F. O. Barlow from the original specimens collected from the Upper and Middle Eocene beds of the Fayûm, Egypt, and now preserved in the British Museum and the Geological Museum, Cairo.

Dr. Walter Kidd, F.Z.S., exhibited lantern-slides of sections of skin from the palmar and plantar surfaces of twenty-four species of Mammals, and the plantar surfaces of seven species of Birds. The functions of the papillary ridges and the papillary layer of the corium in connection with the sense of touch were alluded to.

The following papers were read:—

1. Notes on the Histology and Physiology of the Placenta in Ungulata. By J. W. Jenkinson, M.A., D.Sc., Assistant to the Linacre Professor of Comparative Anatomy, Oxford.

[Received November 27, 1905.]

(Plate III.* and Text-figures 27–33.)

Our knowledge of the minute anatomy of the Ungulate placenta may be said to have begun with the publication in 1882 of Bonnet's paper on the constitution of the so-called "uterine milk" in these mammals. According to Bonnet, the uterine milk of the Sheep is a yellow viscid mass like pus, and consists of a granular coagulable matrix full of masses of degenerating cells and nuclei, of red blood-corpuscles, and of leucocytes which have emigrated through the uterine epithelium. It also contains small rod-like or needle-shaped bodies—the "Stäbchen"—of an albuminous substance, and fat and cholesterin may be demonstrated in it.

As this author rightly insists, this material forms a very valuable food for the developing fœtus; not only can the trophoblast be shown to be absorbing fat even while the blastocyst is still floating freely in the lumen of the uterus, but the cells of this fœtal membrane are also phagocytic and actively ingest the solid particles of the uterine milk. This food-material is of maternal origin; fat is secreted by the uterine epithelium and glands, the red blood-corpuscles are extravasated from superficial capillaries, while the leucocytes emigrate through the epithelial cells, the Stäbchen are formed by the cells of the maternal epithelium, and the degenerating cellular masses result from the extensive disintegration of epithelial and subepithelial tissue.

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* For explanation of the Plate, see p. 96.

More recently the studies of Kolster on the placentation of the Horse, Cow, Sheep, Pig, Roe-deer, and Red-deer have thrown additional light on the mode of manufacture of this valuable food-supply.

This author, while fully corroborating Bonnet's account of the secretion of fat in the extra-cotyledonary uterine epithelium and its glands, and of the copious emigration of leucocytes through the epithelium during the greater part of gestation, has given a more detailed description of the histological nature of these and other processes. In fat-secretion the outer end of the cell with the fat-globules it contains is protruded into the lumen of the uterus or of the gland, pinched off, and ejected; exactly the same process, which evidently resembles very closely the formation of milk in a mammary gland, occurs in the secretion of fat in the crypts of the maternal cotyledons. The fat so secreted is quickly absorbed by the trophoblast.

Another very interesting phenomenon described by Kolster is the production by the glands of a "cellular secretion," in addition to the thin coagulable liquid substance usually found in them; here and there small tracts of the epithelial wall become invaginated into the gland-lumen, and being cut off degenerate and are ejected by the mouths and added to the uterine milk. The epithelial cells so cast out are often accompanied by connective-tissue corpuscles and leucocytes. Bonnet has recently demonstrated a similar "cell-secretion" in the uterine glands of the bitch. These ejected gland-cells form a very important though not an only source for the cellular constituents of the milk. Considerable masses of disintegrating maternal tissue are added to the whole, as well as quantities of red corpuscles. All this material is ingested by the phagocytic trophoblast; the fœtus is thus able to obtain a large amount of proteid food and—from the red corpuscles—the essential iron as well. The result of the intra-trophoblastic digestion of the hæmoglobin is the formation of pigment-masses in the cells of this layer; these masses will sometimes give an iron reaction, but usually not. The pigment was not further investigated by Kolster. A very similar pigment is formed by the extravasation of blood from subepithelial capillaries at the time of heat, the blood-corpuscles being taken up by wandering cells and digested; as a result pigment appears in the cells, while iron can be demonstrated in the fluid in the uterine cavity.

A recent examination of a fairly complete series of stages of the placentation of the Cow and Sheep has enabled me to confirm Kolster's valuable observations in all essential particulars: the secretion of cells in the uterine glands, the secretion and absorption of fat in the cotyledons (I have never succeeded in finding fat in the extra-cotyledonary uterus, though it is abundant in the overlying trophoblast), the disintegration of large masses of maternal tissue, the extravasation of red corpuscles and their ingestion by the trophoblast with consequent formation of pigment, the emigration of leucocytes through the uterine epithelium,—certainly all occur in the manner described by this author. At the same time there are one or two small points on which I am unable to agree with him, such as the disappearance of the epithelial cilia and the mode of formation of the accessory cotyledons; and others where his description or figures are deficient—the histology of the trophoblast, for example. Further, the pigment was not examined spectroscopically by Kolster, and neither Kolster nor Bonnet has paid the slightest attention to a highly important substance, the glycogen of the placenta. Lastly, I have made one or two interesting observations on the anatomy of the "diverticulum allantoidis" and on the origin of the allantoic bodies or hippomanes.

My material includes pregnant uteri containing embryos of from 4 cm. to 60 cm. in length in the case of the Cow, from 14 cm. long to full time in the case of the Sheep, of the after-birth fœtal membranes of the Cow, and non-pregnant uteri both virgin and post-partum.

The preservative fluids used were aceto-corrosive, picro-corrosive, Flemming, and 90 per cent. alcohol. It may be pointed out that for the proper preservation of the maternal epithelial tissues it is essential that the uterus should be pinned out, with the overlying trophoblast and allantois, before it is placed in the fixative.

1. *The Formation of Accessory Cotyledons.*

It is well known that in the Cow and Sheep the maternal cotyledons are formed in certain definite areas which can be distinguished in the virgin uterus (even of the unborn uterus) as rounded prominences of the mucosa—the cotyledonary caruncles. These caruncles consist of a dense mass of vasifactive sub-epithelial connective tissue, and are covered by a columnar epithelium continuous with that which lines the rest of the uterine cavity. They contain no glands.

After impregnation has taken place the caruncles are converted—upon the attachment of the blastocyst to the uterine wall—into the maternal cotyledons, becoming pitted by the crypts in which the fœtal villi lie. The number of cotyledons thus formed is therefore predetermined and definite; but in addition to these principal ones accessory cotyledons of smaller size are formed in the intervening regions throughout the later periods of gestation. The exact mode of their formation presents some points of interest.

The process has been thus described by Kolster: "Die erste Anlage einer solchen accessorischen Placenta äussert sich darin dass eine nicht all zu weite wohl aus einer einfachen Chorionzotte hervorgehenden Epitheltasche in die subepitheliale Kernschicht hineinwächst." With this account I am obliged, in two respects, to disagree: in the first place the new crypt is not formed under the influence of an ingrowing villus, and in the second it does not, in the first instance, grow down into the subepithelial tissue. By carefully preserving maternal and fœtal tissues together, the exact mode of origin of the structures can be made out without difficulty (text-figs. 27 *a–e*).

The first sign of such an accessory crypt (in the Cow) is to be found in the pitting of the uterine epithelium, the underlying subepithelial tissue remaining perfectly smooth and taking no part in the process. The cells which line the bottom of these pits are shorter, the cells which make their sides rather taller than the cells of the surrounding unmodified epithelium. It may be noticed that mitoses are frequently met with in the cells of these pits, though rare in other parts of the epithelium (text-figs. 27 *a*, *c*).

Presently, the under layer of connective tissue still remaining perfectly smooth, a few wandering cells make their way through into the walls of the pit (text-fig. 27 *b*), and this is soon followed either by the formation of connective fibres around these wandering cells or by the extrusion of fibres from the layer below (text-fig. 27 *c*). A small pitted area—with connective tissue and capillaries in the walls of the pits—thus becomes raised above the general level of the uterine surface (text-fig. 27 *c*) and by a continuation of the process a cotyledon is formed. Only after the pits have attained a considerable degree of development do the fœtal villi begin to dip into them; that this is the case is very clearly shown by the fact that while the pits are being formed the overlying trophoblast is absolutely smooth and non-villous.

The cells of the pits, like those of the general epithelium, are at first ciliated (though this is denied by Kolster) and more or less

Explanation of Text-fig. 27 (opposite).

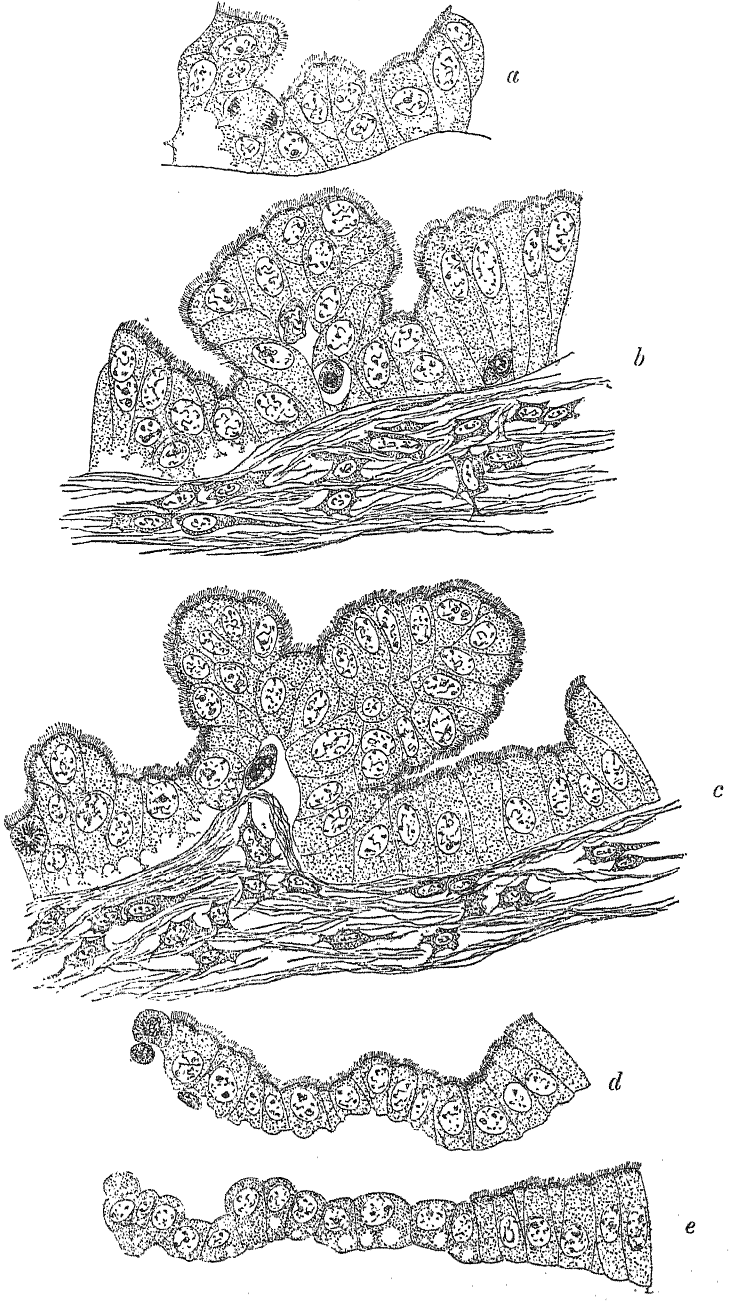
[NOTE.—Text-figs. 27, 28, 29, & 31 are from drawings made with the Camera Lucida, obj. Zeiss 2 mm. achr., oc. comp. 4.]

Details of the formation of an accessory cotyledon in a Cow's placenta of the 6th month.

Fig. *a*. A small epithelial pit is formed; fig. *b*, the wall separating two pits is growing up above the level of the surrounding epithelium. The underlying connective-tissue layer is at present quite undisturbed; fig. *c*, the connective tissue begins to grow up into the pit or crypt-wall. Notice the mitoses.

Fig. *d* shows the somewhat cubical but still ciliated epithelium lining a crypt in one of these newly formed accessory cotyledons; and fig. *e* the continuity of the ciliated with the modified vacuolated epithelium of a rather older crypt.

Text-fig. 27.



columnar, but as the pits develop the lining cells lose their cilia, become cubical, and exhibit a fatty vacuolation of their cytoplasm (text-fig. 27 *e*). At no stage, however, in the formation of these accessory cotyledons is the continuity of the cells lining the crypts with the general uterine epithelium ever lost; on this matter sections of properly preserved material do not allow of a moment's doubt.

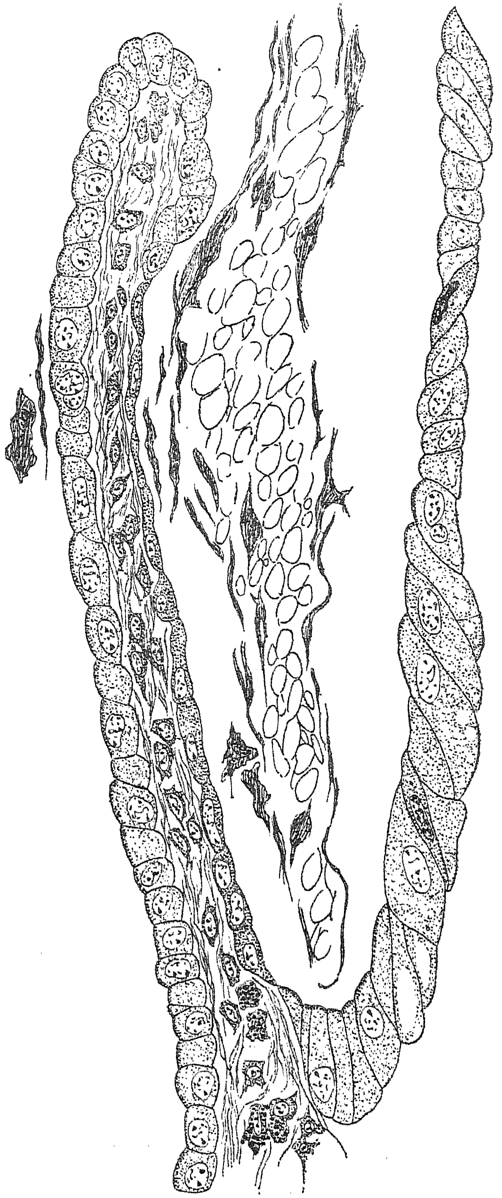
Whether the epithelium lining the crypts of the principal cotyledons is also derived in like manner from the epithelium covering the cotyledonary caruncles, is a point which can only be definitely settled by an examination of the early stages of formation of these organs. Apart, however, from the analogy of the accessory cotyledons, strong evidence can be brought forward in favour of such a view. In both the Cow and the Sheep the epithelium lining the crypts, however much altered it may be, and in the Sheep the alteration is very great, is still continuous at the edges of the cotyledon with the unmodified epithelium outside: this can be made out with the very greatest ease in the case of even the oldest and largest cotyledons of the Sheep, not quite so obviously in the Cow. In passing from the extra-cotyledonary columnar cells (Pl. III. fig. 7) to the flat cells which line the crypts, all transitional forms can be found uninterruptedly adjacent to one another (text-fig. 28). The cells become cubical, then flat, and finally extremely attenuated. Further, places may be found in the crypts where this extreme alteration of the cells has not occurred; small nests of cells were to be seen, particularly at the summits of the crypt-walls and in the deepest portions of their cavities, in which the cubical or even the columnar form is still preserved; and it is interesting to notice that it is from these patches that new diverticula are given off by the solid ingrowth of masses of cells, in which a lumen is subsequently developed, into the connective tissue below (text-figs. 29 *a–e*, p. 81).

So far as my own knowledge goes, I am able to support fully Kolster's contention that in the principal as in the accessory cotyledon the crypts are lined by a secretory epithelium which arises by modification of the cells which clothe the surface of the non-pregnant uterus.

2. *The Histology of the Trophoblast.*

(*a*) The trophoblast consists in the extra-cotyledonary regions of rather tall columnar cells; the outer ends are protruding and apparently amœboid, the cells themselves, as Kolster and Bonnet have recognised, decidedly phagocytic. At the bases of the villi very tall columnar cells are found (Pl. III. fig. 1), which are the principal agents in the ingestion of extravasated maternal red corpuscles, as hæmorrhage of the maternal capillaries takes place most frequently at the summit of the walls separating the main crypts. On the villi the cells are more cubical. It is noteworthy that the fœtal capillaries make their way into the trophoblast and are often separated from the uterine lumen by only the thinnest of cytoplasmic partitions.

Text-fig. 28.



Sheep.—Detail of cotyledonary crypt.

The columnar epithelium of fig. 7, Plate III., is here seen to pass without a break into the flat or cubical epithelium lining one of the peripheral crypts of the cotyledon. This is taken from the same preparation.

(β) In addition to these typical cells I have found in the Cow elements which look remarkably like goblet-cells. They are to be seen (Pl. III. fig. 8, *gl.*) wedged in between the ordinary cubical cells which cover the villi. Each cell contains a goblet-cavity filled with a granular coagulum; the nucleus is small and pressed against the side of the goblet. I have not succeeded in getting the granules to stain with muci-carmine or muchæmatein.

(γ) The large oval binucleate cells (Pl. III. fig. 8, *bi.*), found in both the extra-cotyledonary trophoblast and upon the villi, have been described by both Bonnet and Kolster. Each cell has a very definite superficial membrane, a dense finely granular cytoplasm, and two large oval nuclei provided with a rich reticulum of coarse chromatin granules and two or more plasmosomes. The nuclei may divide mitotically.

According to Kolster, these cells are maternal leucocytes which have migrated through the uterine epithelium, grown at the expense of the cell-débris accumulated in the lumen uteri, doubled their nuclei by amitotic division, and become incorporated in the trophoblast. It is true that these or closely similar cells are occasionally found free between the fœtal and maternal tissues; but apart from that I do not believe there is the least evidence for the view put forward by Kolster. That leucocytes migrate in large numbers during gestation through the maternal epithelium and are found in the "uterine milk" is certainly an indisputable fact; these cells are, however, far larger than any leucocytes that I have ever found, and quite dissimilar to any that I am acquainted with. Moreover, Kolster does not figure a good series of the alleged intermediate stages between the unmodified white corpuscles and these very peculiar cells. The question must remain an open one until the mode of first appearance of these elements in the unattached blastocyst has been ascertained *.

3. *The "Diverticula Allantoidis."*

The ends of the chorionic sac—placed in the cornua uteri—are produced into long, tapering filaments, supposed by the earlier embryologists to be diverticula of the allantois pushed through perforations in the chorion. Bonnet has shown (for the Sheep)

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* Assheton has now shown that these cells are of fœtal origin. See postscript to this paper.

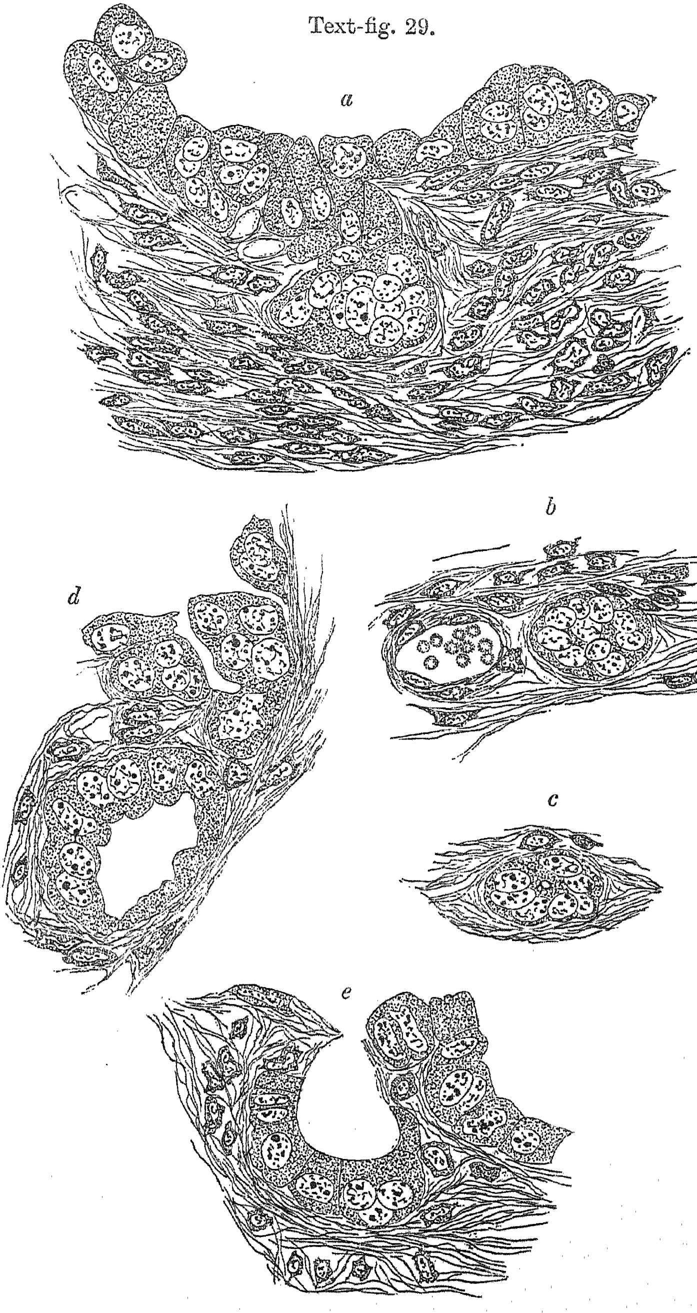
Explanation of Text-fig. 29 (opposite).

Sheep.—Formation of new crypt-cavities by the downgrowth of cell-masses from patches of unmodified—not flattened—epithelium.

In fig. *a* the solid downgrowth is shown in continuity with the crypt epithelium; in fig. *b* it is cut across; in fig. *c* it has a lumen communicating with the crypt-cavity above; in fig. *d* the lumen though well-developed is not yet open; and in fig. *e* the lumen is as yet exceedingly small.

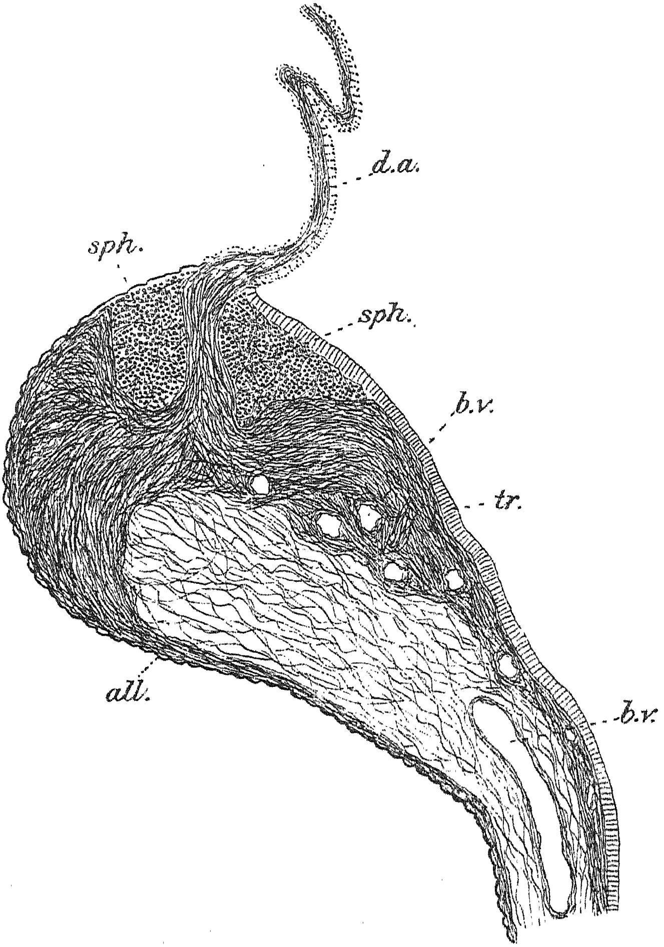
All the figures taken from the basal crypts of a cotyledon of a fœtus measuring 14 cm. (3rd month according to Kolster.)

Text-fig. 29.



that in these terminal processes the chorion as well as the allantois is involved; according to this observer, the chorion is here not vascular, and quickly degenerates and crumples up; it is then "von gelblich käsigem Aussehen," a very apt description of its appearance.

Text-fig. 30.



Section through one side of the chorionic ring and base of the diverticulum allantoidis of the Sheep, *d.a.*; the degenerate trophoblast and degenerate allantoic epithelium are indicated in dotted outline. At the base of the diverticulum allantoidis its connective-tissue lamella passes between the two muscular sphincters (*sph.*) to join the thick connective-tissue of the chorionic ring; here the allantoic epithelium (*all.*) and the trophoblast (*tr.*) are intact. *b.v.*, blood-vessel.

Sections (text-fig. 30) show that outer trophoblastic and inner allantoic epithelium are alike involved in the process of degeneration, the disintegrating cells being added to the mass of uterine milk in which the twisted crumpled filament is embedded, all, indeed, that remains is the fibrous connective-tissue lamella which separated the two epithelial layers.

The structure, however, to which I wish here to draw attention is a thickened fibrous ring which lies at the base of the terminal filament and surrounds the narrow aperture by which the central communicates with the terminal portion of the allantoic cavity. The ring arises by a dense local hypertrophy of the connective tissue (splanchnopleuric and somatopleuric) separating the epithelia of the allantois and trophoblast: on the central side of the ring blood-vessels (*b.v.*) are found in this connective tissue, and the two epithelia (*tr.* and *all.*) persist; on the terminal side the epithelia degenerate and the blood-vessels are absent, the supporting lamella of connective tissue alone remains. This lamella springs from the thickened "chorionic ring," as I will call it, and at its base are two rings of muscular tissue forming a sphincter (*sph.*), which apparently serves to prevent the escape of allantoic fluid after the disintegration of the terminal portion.

The figure, in which one half of the chorionic ring only is shown, is taken from a section of the membranes of an embryo sheep measuring 27 cm. (last month of pregnancy).

4. *The Distribution of Glycogen in the Placenta.*

The presence of this body in the Ruminant fœtal membranes did not escape the notice of its discoverer, Claude Bernard.

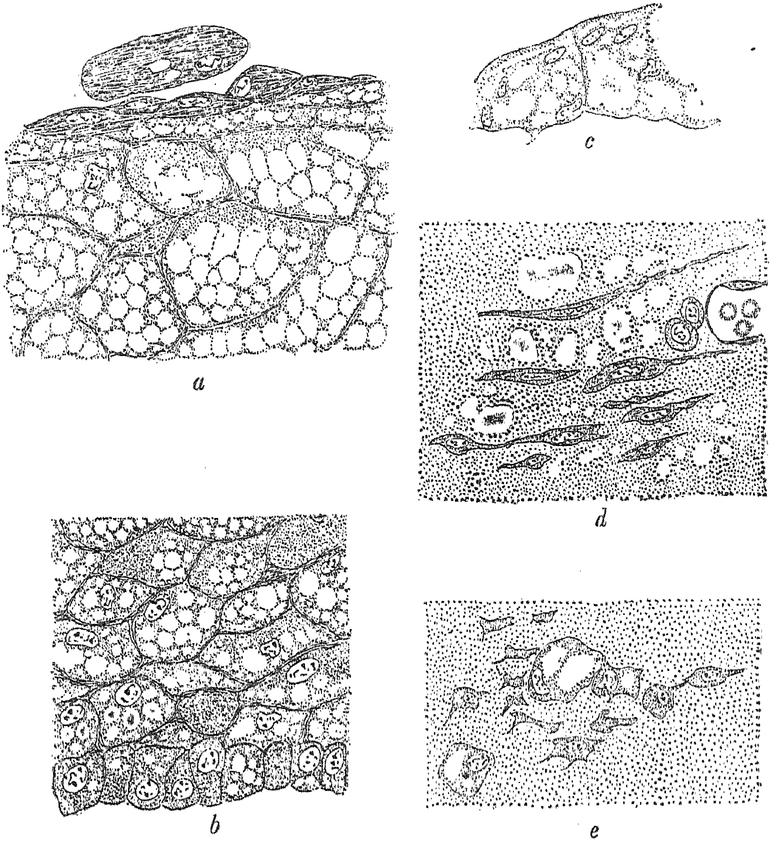
Bernard showed that the rounded or irregular, flattened or papilliform bodies with which the internal surface of the amnion is covered contained large quantities of glycogen, the quantity increasing up to about the fifth month of gestation and then slowly diminishing towards the end; with the diminution of the glycogen he described a fatty degeneration of the amniotic bodies and the deposition of crystals of calcium oxalate. He further demonstrated the presence of glycogen during the earlier stages of pregnancy in many embryonic tissues—the skin, lungs, intestinal villi, uterus, bladder, ureters, renal tubules, and muscles; not, however, in the liver until late in fœtal life, when it had disappeared from the other organs. Bernard regarded the amniotic bodies as a storehouse of reserve carbohydrate, and pointed out that the percentage of sugar (dextrose) found in the amniotic fluid steadily increased as the glycogen in the amnion diminished.

Creighton has stated that glycogen may be found also in the fœtal cartilages, especially during bone-formation, and in the choroid plexuses of the brain.

To these facts I am able to add but little. I have, however, succeeded in finding glycogen in the uterine epithelium, both superficial and glandular (in the Cow), and in the subepithelial connective tissue in the Sheep, and further in the uterine milk.

Moreover, it occurs in the trophoblast, in the connective-tissue cells of the chorion, and in the allantoic epithelium. It appears to be absorbed mainly by the extra-cotyledonary trophoblast, if not entirely so. I have not found it in the villi.

Text-fig. 31.



a and *b*. Amniotic epithelial thickening of a Cow of 4 months. Notice the abundant glycogenic vacuolation. *a*, the superficial; *b*, the deep strata.
c. Glycogenic epithelium of the allantoic stalk. (Length of fœtus 30 cm., 5th month according to Kolster.)
d, *e*. Glycogenic connective-tissue cells in the walls of one of the umbilical blood-vessels of the same fœtus as the last.

The only other case, which I am aware of, in which glycogen has been found in the uterine epithelium is the human uterus. Langhans has described it here in the cells of the superficial epithelium and of the glands. It occurs, of course, in abundance in the subepithelial tissue of the Rodent uterus (Mouse and Rabbit), and in the former animal is absorbed and stored by special trophoblastic glycogenic cells in much the same fashion as by the amniotic bodies of the Ungulata.

The glycogen secreted by the Ungulate uterus is, however, not nearly sufficient to account for the very large quantity found in the body and adnexa of the fœtus; most of this must be formed synthetically.

Finally, I have ventured to give figures (text-figs. 31 *a*, *b*) of the stratified epithelium of the amniotic bodies. The lowest layer is cubical; this is succeeded by sheets of polyhedral cells, which become larger and flatter towards the surface.

All the cells, even the cubical cells of the bottom layer, are vacuolated with glycogen. The vacuoles are separated by excessively delicate walls; these may break down and the cell thus become converted into a bag containing but one large mass of glycogen. In older stages, when the glycogen is used up, the cells become flattened and the nuclei stain faintly.

Text-figs. 31 *c*–*e* show the glycogenesis in the epithelium of the allantoic stalk, and in the connective-tissue cells of the coats of the umbilical blood-vessels.

5. *The Pigment of the Placenta.*

Kolster has very rightly emphasised the great physiological importance of the ingestion of extravasated maternal red corpuscles by trophoblastic cells. The hæmoglobin so taken up is digested and split into an iron-containing and an iron-free constituent. The former is carried away by the fœtal blood-vessels and stored up in large quantities, principally in the liver of the embryo, as a reserve to be used during lactation*, as the milk contains little or no iron. The latter is deposited in the cells as a pigment, occurring in such quantities as to give—especially in the later stages of gestation—a deep brown colour to the fœtal cotyledons.

The extravasation, and consequently the ingestion, of blood-corpuscles takes place mainly in the cotyledons; the hæmorrhages occur principally at the summit of the walls separating the primary crypts, and the trophoblastic cells, which are actively concerned in the ingestive process, are the long columnar elements which lie at the bases of the large villi.

The stages of ingestion and digestion of the blood-corpuscles are as follows:—The cells in question have outwardly-protruding amœboid processes, by which they engulf the corpuscles (Pl. III. figs. 1–3); the ingested corpuscles are often so numerous as to almost entirely fill the body of the cell. Inside the cell the corpuscles—often aggregated in small clumps (fig. 3)—become gradually paler, and change their staining reaction and their form. In picro-nigrosin the freshly-ingested corpuscles, like those outside, take up the picric acid, but gradually gain a stronger affinity for the nigrosin, and stain blue or grey; at the same time their shape becomes irregular. These irregular masses seem to be enclosed in small cavities or food-vacuoles. Presently small granules of a yellowish-brown pigment are seen to have been deposited on the surface (fig. 5) of the included masses, and this process continues until the whole is converted into an irregular dark brown mass (fig. 6). Both freshly-ingested corpuscles and pigment may be observed in one and the same cell (figs. 2 & 3). Of the nature of this pigment Kolster says little beyond the statement that it is a hæmoglobin derivative, and that some of the granules will give an iron reaction. Such granules are probably similar to the iron-albuminate particles which I have described in the uterus of the Mouse, and which commonly occur in old blood-extravasates. Bonnet alludes to them as hæmatoidin crystals.

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* Bunge has shown that the percentage of iron in the new-born puppy (·72 per cent. of the ash) is six times as great as that in the dog's milk (·12 per cent.), and further that the proportion of iron in the new-born puppy is five to nine times that in the adult dog. Of the assimilation of iron by the fœtus Bunge remarks: "If the bulk of the organic compounds of iron were afforded by the mammary gland, it might become a prey to bacteria in the alimentary canal before it had time to be absorbed. But if it enters the infant organism through the placenta its safety is assured."

I myself have not been able to get an iron reaction with these masses in any case. If sections are treated with warm nitric-acid alcohol (by Macallum's method) for 24 hours, and then with acid ferrocyanide of potassium, the nuclei of the cells become an intense blue, but the pigment remains unchanged except that it is a little paler. I am, however, able to bring forward a certain amount of evidence as to the nature of the hæmoglobin derivate with which we have here to deal.

I did not attempt to make a chemical analysis of the pigment, but merely to extract it by different solvents. I proceeded by a twofold method:—

(1) I soaked the fœtal cotyledons in water (to get rid of the hæmoglobin in the blood), ground up the tissues in a mortar, filtered, and dried the pigment which had been collected on the paper. This was then dissolved in hot absolute alcohol, and gave a greenish-yellow solution, which, however, showed no absorption-bands. I failed to get the residue to dissolve in ether or chloroform (although, as will be seen below, Dr. MacMunn has shown that it will dissolve in these media) or boiling water, although soluble with a greenish colour in 6 per cent. aqueous potash; in solution in 5 per cent. nitric or sulphuric acid in 90 per cent. alcohol it turned reddish.

(2) I dried the cotyledons thoroughly, then pulverised in a mortar and dissolved in absolute alcohol. The solution was reddish brown, and, on examination with the spectroscope, showed two dark bands very nearly in the position of the bands of oxyhæmoglobin. I supposed that these bands were due to the hæmo-

globin of the fœtal blood which was included, of course, in the powder. This, however, is not the case. At Dr. MacMunn's suggestion I took some pure hæmoglobin (from centrifugalised blood) and treated it in exactly the same way—that is, dried, pulverised, and boiled it in absolute alcohol. The alcohol turned only a faint straw-yellow colour and showed no bands whatever. I sent my solutions to Dr. MacMunn, who has most kindly submitted them to a thorough spectroscopic investigation.

I take this opportunity of expressing my great indebtedness to him for the trouble he has taken, and for his courtesy in permitting me to publish his report, which I now give verbatim.

I. Solution obtained by the first of the two methods described above from the fœtal cotyledons of the Cow.

"Solution greenish yellow, shows no bands, absorbs small bit of violet end. This fluid evaporated down on water-bath leaves a greyish-brown residue with a peculiar smell and resinous appearance. This residue is soluble in ether, yellowish solution, giving no bands but absorbing a little bit of the violet end as before. On evaporating this a brownish residue is left, this soluble in chloroform, yellowish solution. This solution shows no bands, only absorbs a little bit of violet end.

"On adding fuming nitric acid, no colour change and no spectrum change. It is not, therefore, bilirubin, nor biliverdin, nor a lipochrome."

II. A solution obtained by the second of the above-described methods from the virgin uterus of the Sheep.

"The solution is greenish yellow, has no absorption-bands, but cuts off a little bit of the violet end; is probably identical with above from Cow."

III. A solution obtained by the *second* method from the fœtal cotyledons of the Sheep.

"Filtered, filtrate has a yellowish-red colour.

"On spectroscopic examination two faint bands are seen in the green, looking at first sight like the oxyhæmoglobin bands; there is also a slight shading in the red end of the spectrum.

"Evaporated down by heat, it leaves a brownish oily-looking residue; a considerable portion of this is soluble in rectified spirit. This solution has a yellow colour with a tinge of red; this shows two faint bands, which seem to occupy the position of the oxyhæmoglobin bands. The relative intensity of shading of these bands was not, however, the same as of the oxyhæmoglobin bands. Their measurements are:—

$$(1)\ \lambda\, 593 - 574,$$
$$(2)\ \lambda\, 556{\cdot}5 - 531.$$

"This spirit solution was now evaporated down on the water-bath and left a brownish residue. On extraction with absolute alcohol the same yellow solution with a reddish tinge is obtained as before, giving the bands with *exactly the same readings*.

"This alcohol solution was again evaporated down and the residue dissolved in ether, which dissolved a considerable portion, giving a yellowish solution with a reddish tint; this gave two bands:—

(1) λ 593 or 594·5 – 577,
(2) λ 558 – 533·5.

"This shifting is due to the influence of the solvent.

"There also seems to be a *slight* shading between λ 516 and 496?

"This ether solution was evaporated down and the brown residue extracted with chloroform; this formed a reddish solution, which contained oily-looking red drops floating undissolved on the surface.

"The two bands now are:—

(1) λ 596 – 574,
(2) λ 558 – 533·5.

"The first is not as dark as the second.

"A faint greenish fluorescence seems to be present in all these solutions; it does not disappear on filtering.

"The chloroform solution was next evaporated down and the residue dissolved in rectified spirit.

"The addition of ammonia or of caustic soda to this solution causes precipitation, and, in the filtrate, diminishes the intensity of the colour of the solution and the shading of the bands, but does not appear to alter their position. On adding one drop of sulphuric acid the fluid becomes slightly turbid, and the two bands in the filtrate have disappeared to be replaced by two others, (1) before D and (2) in the green, which are difficult to measure, but whose position is approximately as follows:—

(1) λ 607 – 596,
(2) λ 568 – 547.

"These recall at once the bands of acid hæmatoporphyrin, the positions of which are:—

(1) λ 610 – 591,
(2) λ 585 – 567·5.

"It is to be noted, however, that the addition of alkalis does not produce the usual four-banded spectrum of alkaline hæmatoporphyrin, but Garrod and others have described in urine a two-banded neutral hæmatoporphyrin spectrum.

"Fearing that possibly a *four-banded* alkaline hæmatoporphyrin spectrum might have been present but have been passed over owing to the weakness of the solution, a layer of fluid (absolute alcohol and ammonia) 50 mm. deep was examined in a long spectroscope bottle, but no bands except the following could be seen :—

(1) λ 594·5 — 572·5,
(2) λ 556·5 — 531.

" Other experiments were made to prove that the pigment was not hæmatin ; *e. g.* ammonium sulphide was added, but no reduced hæmatin spectrum appeared. Caustic alkalis also failed to change the spectrum into that of alkaline hæmatin, acids into that of acid hæmatin, which would have occurred if that pigment had been present.

" Let us now compare the spectrum of the pigment in alcoholic solution with that of an as equally as possible dilute aqueous solution of oxyhæmoglobin :—

Placenta pigment.	Oxyhæmoglobin.
(1) λ 593 — 574,	(1) λ 586 — 568,
(2) λ 556·5 — 531,	(2) λ 552 — 525.

" (See Hoppe-Seyler, Handbuch, 1903.)

" This pigment therefore appears to be more nearly related to hæmatoporphyrin than to any other known decomposition-product of hæmoglobin."

IV. Solution obtained from the fœtal cotyledons of the Cow by the *second* method.

" The alcoholic solution shows the two-banded spectrum, is the colour of fairly deep sherry ; filtered, the filtrate is reddish yellow and shows two bands :—

(1) λ 593 — 577, second reading λ 594·5 — 575,
(2) λ 556·5 — 534·5, second reading λ 556·5 — 533·5,

and in addition a faint shading nearer the violet.

" The solution was evaporated on the water-bath, but owing to the presence of some fatty matter remained fluid while hot.

" An aqueous solution of the residue is faintly yellow, but shows no bands or fluorescence.

" The residue was brownish, in thin parts brownish yellow. The absolute alcohol solution of this residue is reddish yellow with a suspicion of greenish fluorescence ; it gives two faint bands :—

(1) λ 593 — 574,
(2) λ 558 — 536.

" The violet end of the spectrum is cut off at λ 487.

" Ammonia produces turbidity, and diminishes, in the filtrate, the intensity of the bands, but their position is unaltered.

" On adding a little H_2SO_4 to an alcoholic solution slight precipitation is produced. The filtrate is of a deep yellow sherry-colour and the bands referred to above (in the Sheep) resembling those of acid hæmatoporphyrin are seen; the violet end is also cut off.

"This pigment seems evidently to be identical with the banded one obtained from the Sheep.

"It is to be noted that none of the solutions in the case of either the Sheep or Cow was coloured the deep red characteristic of hæmatoporphyrin. This was probably due (α) to the small amount of the hæmatoporphyrin-like pigment present, and (β) to impurities."

From this report of Dr. McMunn's it seems quite clear that two distinct pigments are present in the Ungulate placenta: (1) a pigment soluble in alcohol, ether, and chloroform, which shows no bands, but absorbs a little of the violet end of the spectrum; (2) a pigment soluble in the same three media, but giving in neutral solution two bands very nearly but not quite in the position of the bands of oxyhæmoglobin, in acid solution two bands almost exactly in the position of the bands of acid hæmatoporphyrin, but in alkaline solution showing only two bands, in the same position as in the neutral solution, and not the four bands of alkaline hæmatoporphyrin.

The first of these was obtained from the cotyledons of the Cow by crushing the tissues, after removal of (at any rate most of) the hæmoglobin by water, and from the virgin uterus of the Sheep by drying the tissues, *with the contained hæmoglobin*, and powdering; the second was obtained from the cotyledons of both Cow and Sheep by the second method, involving the retention of hæmoglobin with the pigment. It seems probable that the first pigment is present as well as the second, though masked by it, in the cotyledons of the Sheep.

That the second pigment is not produced from the included hæmoglobin by the treatment adopted is proved, first, by its absence in the virgin uterus of the Sheep, and, second, by the failure to get a solution showing the bands by boiling dried hæmoglobin in absolute alcohol. This second pigment then, if not the first, would appear to be new to physiology, though related to hæmatoporphyrin. The name hæmatophæin may be provisionally given to it. It is a hæmoglobin derivative and from it bile-pigments may be formed. This will be shown in the next section.

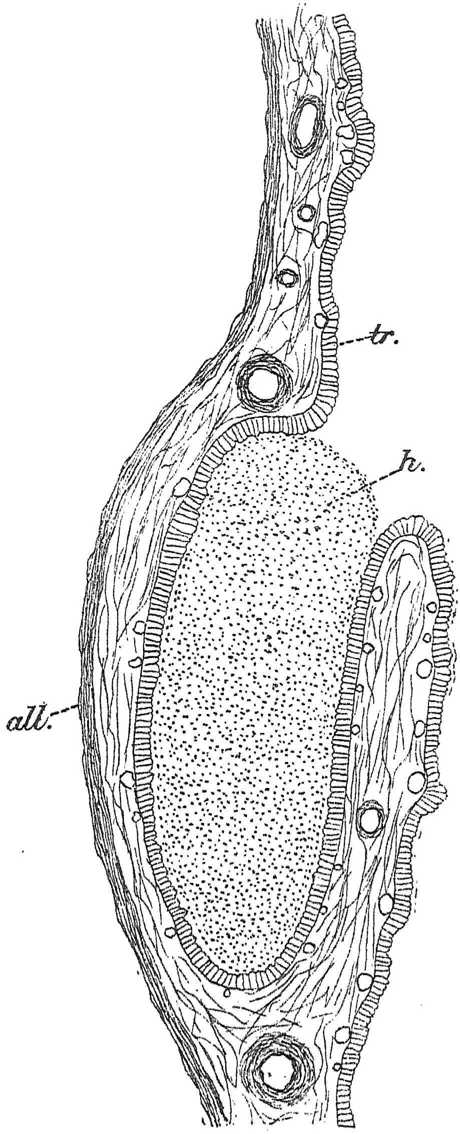
6. *The "Hippomanes" or Allantoic Bodies.*

Although the curious rounded or elongated, often flattened, sometimes soft, sometimes hard and brittle bodies found floating in the allantoic fluid have been familiar objects for many centuries, the exact mode of their formation has not, to the best of my knowledge, been yet accurately described.

They occur in both the Cow and the Sheep, being larger in the latter. Their colour in the former case is whitish or pale yellow, in the latter a dirty brown.

Their origin will be considered first in the Sheep. From the fact that they are often found attached by a pedicle to

Text-fig. 32.



Uterus of Sheep.

Section through a mass (*h.*) of uterine cellular and nuclear débris embedded in a pocket of the trophoblast (*tr.*). This is an early stage in the formation of a hippomanes or allantoic body. *all.*, allantoic epithelium.

the wall of the allantois, and that sometimes they may be seen in the connective tissue of the chorion, it has been supposed that they originated in this position (Bonnet, Turner). It has apparently escaped the notice of these observers that exactly similar bodies are to be found outside the chorion, between it and the wall of the uterus.

It has already been remarked that the lumen of the uterus is, during gestation, occupied by a considerable mass of slimy cellular débris, the so-called uterine milk. The disintegrating cells composing this viscid mass are derived in part from the cellular secretion of the glands, in part from the extensive degeneration of tracts of maternal epithelial and connective tissue; it includes quantities of extravasated blood, and is permeated by leucocytes. It is by the local accumulation of this matter that the allantoic bodies are formed. Such aggregations may be found lying either freely between fœtal and maternal tissues or enclosed in pocket-like diverticula of the trophoblast (text-fig. 32, p. 91). This is the first stage of their incorporation into the allantois; and from this the transition to the following steps is easy—their situation in the connective tissue of the chorion, their attachment by a stalk to the allantoic wall, and their liberation into the allantoic cavity.

Sections show that inside and outside the allantois these bodies have always the same structure—a granular coagulum containing quantities of cell-detritus, with degenerating nuclei which either stain very faintly or are broken up into dense homogeneous spherules, globules of fat and small masses of glycogen, and infiltrated by leucocytes. Sometimes a delicate cellular membrane—the remains possibly of the trophoblastic pocket, or more probably of the allantoic epithelium—still surrounds these bodies after they have found their way into the allantoic cavity.

Whether the allantoic bodies of the Cow are also formed in this way I do not know, as I have never observed them lying in pockets of the trophoblast. Bodies quite similar to those of the allantois are certainly found between the trophoblast and the uterus, both in and between the cotyledons; but the remarkable thing about them is that they have exactly the structure of the degenerate epithelial thickenings of the amnion, and, like these latter, are impregnated with typical "envelope" crystals of calcium oxalate. The bodies found in the allantois, as well as the allantoic fluid itself, contain the same salt, as Lassaigne showed nearly a century ago. It is possible, therefore, that in the Cow the disintegrating epithelial thickenings of the amnion pass on the one hand into the allantoic cavity, on the other into the uterus, and not from the uterus into the allantois in the manner described for the Sheep.

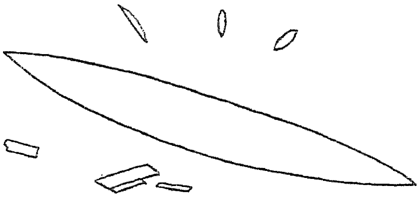
It may be noticed here that the hippomanes of the Mare are also saturated with calcium oxalate.

Lastly, the bodies found between the trophoblast and the uterus of the Cow are often, especially when small, infiltrated with bilirubin. With fuming nitric acid the succession of colours characteristic of Gmelin's reaction is at once obtained.

I have found exactly similar bodies in the Pig, although, as I only obtained these with the after-birth, I cannot say whether they were inside the allantois or on the outside of the chorion. From these I succeeded, by drying, dissolving in chloroform, and crystallizing-out, in obtaining small lanceolate and rhomboidal crystals of bilirubin (text-fig. 33).

These small bilirubin bodies of the Cow are found principally in the cotyledons. Later on they seem to lose their bile-pigment; for between the extra-cotyledonary trophoblast and the uterus only bodies of a paler yellow are found. The allantoic bodies are nearly white.

Text-fig. 33.



Rhomboidal and lanceolate crystals of bilirubin obtained from a chloroform solution of the dried allantoic bodies of the Pig. Drawn with Zeiss obj. 2 mm. achr., comp. oc. 6.

The bilirubin appears to arise by further modification of the yellow-brown pigment of the placenta; but whether it is formed inside trophoblastic cells from ingested corpuscles and then passed out, or whether it arises extra-cellularly in the maternal extravasations, and if so, whether its formation is due to any digestive activity of the trophoblast or not, I am afraid I am unable to say. From the analogy of what occurs in such extravasations as bruises, it would appear that the hæmoglobin derivatives might be formed, not only inside (as is undoubtedly the case), but also outside the cells of the trophoblast; for the yellow-brown pigment described in the last section certainly occurs, not only in the blood-extravasations in the crypts, but even in the maternal tissues and blood-vessels (Plate III. fig. 4).

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——. "Mémoire sur une nouvelle fonction du placenta." Ann. Sci. Nat. (4) x. 1858.

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Postscript.

Since this paper was read, an important memoir has been published by Assheton ("The Morphology of the Ungulate Placenta, &c.," Phil. Trans. B. 198, 1906), in which the author describes a very complete series of stages in the formation and development of the placenta of the Sheep.

The most interesting point of this description is the origin of the cells which line the crypts of the maternal cotyledons from the binucleate cells of the trophoblast.

According to Assheton, the whole of the uterine epithelium degenerates and disappears at about the eighteenth day of pregnancy. In the extra-cotyledonary regions it is eventually regenerated (12th week); but in the cotyledons its place is taken by cells of fœtal—trophoblastic—origin, the binucleate cells, which are also, indeed, instrumental in its destruction. The binucleate cells in question are first seen (15th day) to be deeply seated in the trophoblast; presently, however, they come to the surface and so into contact with the uterine epithelium, between the cells of which they insinuate themselves, and so "pass down to the base of the layer and force themselves between the epithelium and the sublying stroma." The epithelium thus cut off from its source of nutrition dies, and its room is occupied by a more or less complete layer of flattened cells, which Assheton compares to the plasmodiblast layer of the trophoblast described by Van Beneden in the Bat and Rabbit, and present in many other forms. The formation of this plasmodiblast continues throughout pregnancy.

In asserting the trophoblastic origin of these cells, Assheton relies on the following facts:—

(1) They resemble the binucleate cells in the staining capacity of their cells and nuclei.
(2) The presence in them of vacuoles, which is at this stage a characteristic of these (the binucleate) cells.
(3) Nuclei occur in pairs in the lining of the crypts, as in the binucleate cells.
(4) The number of binucleate cells in the trophoblast diminishes during gestation.

(5) "The layer in question is clearly not an attenuation of an ordinary epithelium," and is not secretory, as, *e. g.*, is the epithelium lining the crypts in the Cow, which Assheton admits to be of uterine origin.

As explained in the body of the paper, my own observations do not permit me to speak at first-hand of the origin of the cells lining the crypts in the principal maternal cotyledons. I am, however, certain that in the accessory cotyledons of the Cow the crypts are lined by an epithelium which is a modified uterine epithelium, and that in the principal cotyledons of both Cow and Sheep the extra-cotyledonary columnar uterine epithelium is perfectly continuous with the modified epithelium of the crypts. The latter in the Cow is simply cubical; in the Sheep it is more seriously altered, flattened, and often interrupted. There are places, however, in which the cells retain, as I should put it, their columnar form; and from these cell-nests diverticula are produced which line new crypts. From these facts I have inferred that, in the principal cotyledons, the lining is also of uterine origin.

Still there is no necessary contradiction between this view and that put forward by Assheton; for it is perfectly conceivable that the cells in question may originate in different ways in the principal and accessory cotyledons, and that the continuity observed in the former between extra- and intra-cotyledonary epithelia is secondary. I do not think, however, that Assheton has proved his, admittedly difficult, case; for

(1) Similarity in staining is not a very safe criterion; other nuclei and cell-bodies—*e. g.*, those of subepithelial cells—often stain intensely; also the nuclei of the binucleate cells are often larger, more spherical, and paler than are those of the cells lining the crypts, and in his fig. 40 Assheton figures nuclei of "plasmodiblast" cells which are quite pale.

(2) Vacuoles—of fat and glycogen—certainly occur in the uterine epithelial cells, both inside and outside the cotyledonary caruncles.

(3) The nuclei of the layer lining the crypts do not always occur in pairs, but very frequently in heaps, in the cell-nests I have alluded to, as Assheton's own figures show.

(4) The lining epithelium of the crypts undoubtedly contains fat-globules, and fatty cellular débris is found in the crypt lumen; these cells are therefore as certainly secretory here as they are in the Cow.

(5) The asserted degeneration of the uterine epithelium is very probably largely illusory. Where I had at first supposed that the uterine epithelium had disappeared I have often found subsequently that, by more careful preservation, it could be demonstrated without difficulty.

Although there is no inherent improbability in the account given by Assheton, and indeed some such intermediate form between what he calls the plicate and cumulate types of placenta may at least be supposed to have once existed, I must still, for the reasons given above, express, to my great regret, my inability to accept his conclusions until stronger evidence is forthcoming.

EXPLANATION OF PLATE III.

All the figures were drawn with the Camera Lucida, obj. Zeiss 2 mm. achr., oc. comp. 4.

Fig. 1. Cow. Phagocytic columnar trophoblast-cells from the base of a fœtal villus. (Length of fœtus 7·5 cm.; about 3rd month.) (pp. 78, 86.)

Figs. 2 & 3. Phagocytosis in the trophoblast of the Sheep (nearly full time). In fig. 2 notice the aggregation of the ingested corpuscles into clumps. (p. 86.)

Fig. 4. Cow, 4 months. Brown pigment-granules
(α) in maternal blood-vessels (on the right);
(β) in the cubical epithelium of the crypt (in the centre);
(γ) in the trophoblast of a fœtal villus (on the left). (p. 93.)

5. Cow, 6th month. Trophoblast at the base of a villus. One of the cells contains an ingested mass (compare fig. 1); small brown pigment-granules are forming upon this. (p. 86.)

6. Cow, 4 months. A later stage in pigment-formation. The cells contain large irregular yellow-brown masses. (p. 86.)

7. Full-time epithelium of the Sheep. Normal uterine epithelium from the outer surface of the cotyledon. Note the basal vacuoles and the brown pigment, derived from the hæmoglobin of extravasated corpuscles, in the subepithelial connective-tissue cells. (p. 78.)

8. A small portion of a section through a villus; from a Calf of about the 3rd month (length 9 cm.). Notice, in the trophoblast, cells which look like goblet-cells (*gl.*), and large oval binucleate cells (*bi.*). The capillaries (*cap.*) come very close to the surface; *c.t.*, connective tissue. (p. 80.)

2. Note on the Cavies of the Genus *Dolichotis* and on Living Specimens of *D. salinicola*. By Sir Edmund Loder, Bt., F.Z.S.

[Received February 6, 1906.]

(Plate IV.*)

There had been some little confusion and controversy with regard to the three species or subspecies of *Dolichotis* until the subject was cleared up by Mr. Oldfield Thomas in the 'Annals and Magazine of Natural History,' April 1902.

In Proc. Zool. Soc. 1875 there is a paper by Dr. Burmeister, of the Museum at Buenos Aires, in which he describes and gives a figure of one of two specimens which he had secured from Dr. Berg.

He recognised them as a new species under the name of *Dolichotis salinicola*. Both specimens are stated to have been young.

In Proc. Zool. Soc. for 1876 there is a second paper by Dr. Burmeister, called "Additional Note on *Dolichotis salinicola*,"

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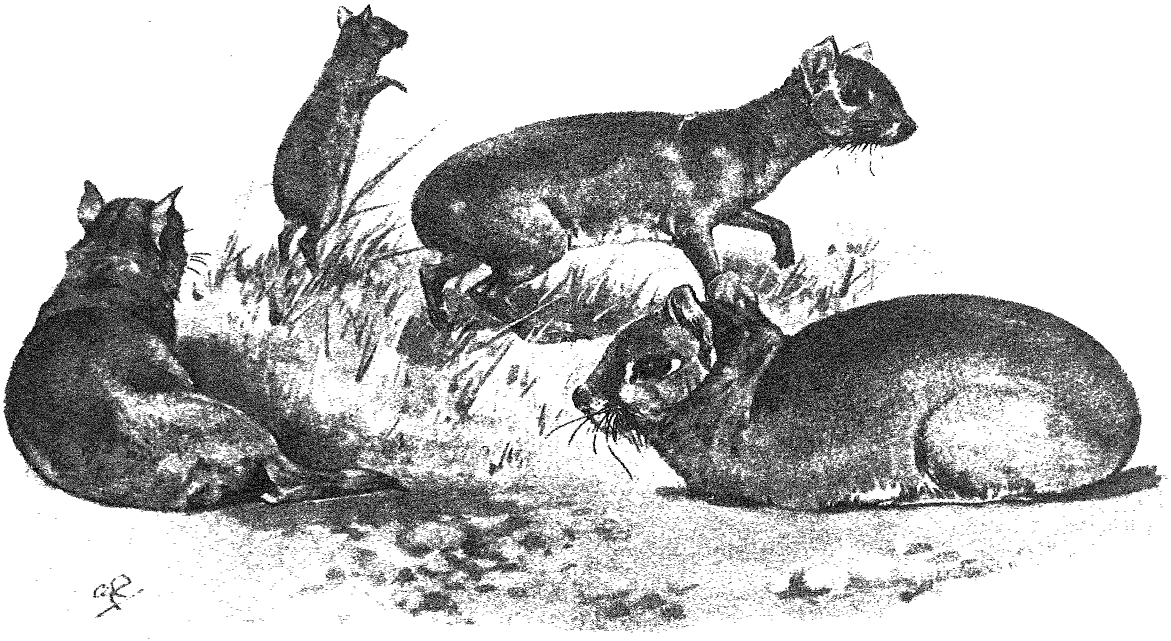
* For explanation of the Plate, see p. 97.

P.Z.S. 1906, vol. I., Pl. IV.



DOLICHOTIS SALINICOLA.

in which he describes two fully adult living specimens. He says:—"The two living specimens, which are now under my inspection, show that my former description was taken from very young specimens of about half their full size, and that this northern species comes much nearer in size to the southern species (*Dolichotis patagonica*) than I was formerly led to suppose."

It is now quite clear from specimens collected by Mr. P. O. Simons in 1901, and described by Mr. Oldfield Thomas, that the living specimens described by Dr. Burmeister in his second paper were *Dolichotis magellanicus centricola* and not *Dolichotis salinicola*, and that those described in his first paper were full-grown or nearly full-grown specimens of the dwarf species *Dolichotis salinicola*, which I have now alive in my possession.

Both these species occur in the same region near Santiago del Estero in Northern Argentina, so that confusion was easy.

The common Patagonian Cavy is conspicuous for a broad dark band above the white rump-patch. This black band is wanting in *Dolichotis salinicola* and also in the larger *Dolichotis magellanicus centricola.*

EXPLANATION OF PLATE IV.

Dolichotis salinicola.

3. Description of a new Fly of the Family *Tabanidæ*.

By Gertrude Ricardo.

[Received December 7, 1905.]

Melissomorpha, gen. nov.

Formed for a fly from Rungaroom, Sikhim, in the British Museum Collection, which closely mimics *Apis dorsata* F., an Indian species.

The genus belongs to the *Pangoninæ* division of the family *Tabanidæ*, which is distinguished by the hind tibiæ being furnished with spines, ocelli usually present, and the third joint of the antennæ consisting of eight divisions, with no tooth.

This genus will come under No. 9 in my table of genera of *Pangoninæ* in the Ann. Mag. Nat. Hist. (7) v. p. 98 (1900): "Proboscis scarcely extending beyond the palpi," which distinguished *Apatolestes*, a North American genus. The two genera may now be divided thus:—

Having the appearance of a Bee (*Apis*). All the tibiæ wide and flattened ....*Melissomorpha*, gen. nov.
Not having the appearance of a Bee. The tibiæ not wide and flattened ....*Apatolestes* Will.

Melissomorpha, gen. nov.

Generic description.—Antennæ eight-jointed, ocelli present, forehead at the vertex protuberant. Head bee-like in shape, the antennæ inserted rather more than half way down the head. Abdomen with six segments, the second one the largest. Proboscis short, hardly projecting beyond the palpi. Legs with all the tibiæ wide and flat, like those of the ordinary hive-bee (*Apis mellifera* L.), with fringes of black hairs on each side, the hind tibiæ being largest, not, however, concave as in the bee. Wings with all the posterior cells open and the anal cell closed; no appendix.

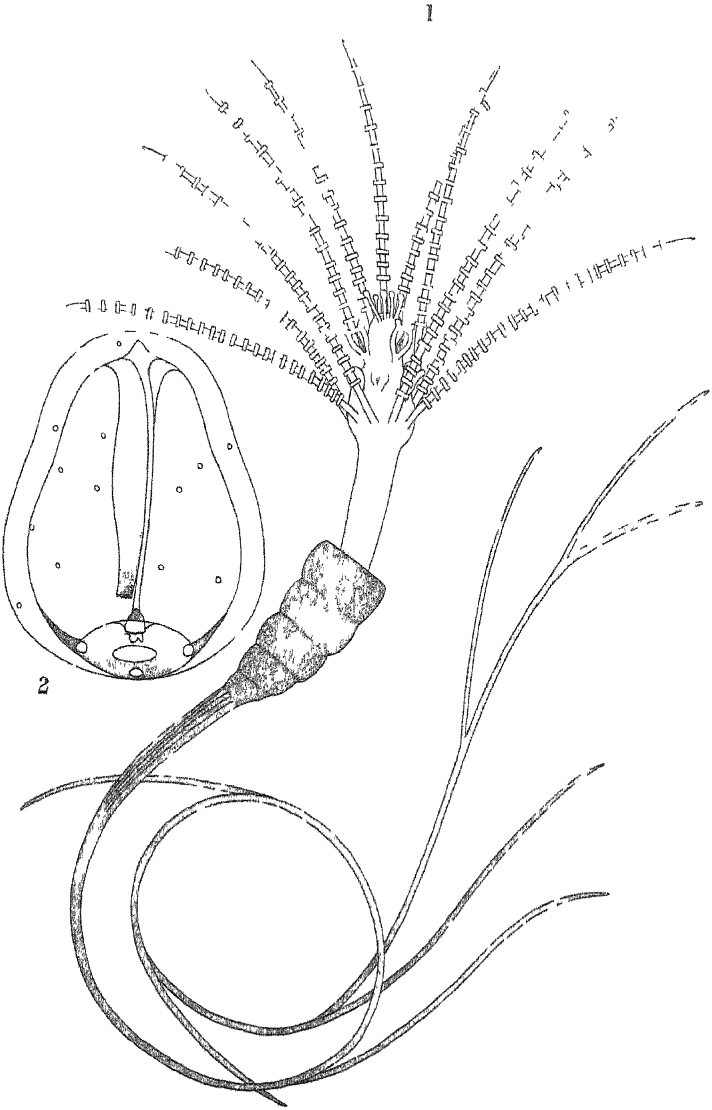
MELISSOMORPHA INDIANA, sp. n.

The single specimen on which this genus is founded is a marvellously close imitation of *Apis dorsata* F.: when placed near the latter it has a wonderfully general resemblance to it, though away from all the natural surroundings. The colouring and shape of the abdomen distinguish it and, of course, the absence of the second pair of wings.

The type is a female from Rungaroom, 7000 feet, 7 miles from Darjeeling, April 1900 (*Col. Bingham*).

Black. Face brown, with black pubescence and some golden hairs intermixed. Forehead long, equal in width, rather broad, black with brown tomentum and black pubescence and some golden hairs; the vertex is shining black, protuberant, with three large reddish-brown ocelli, thence the forehead slopes downwards to the antennæ, which are reddish brown, the third joint being darker; they are long and slender, the first joint nearly twice as long as the second, both with black pubescence, the third joint with the first division as long as the other five, which are short and equal in size, with the exception of the last one, which is longer and ends in a point. Palpi yellowish, long, the first joint short, stout; the second long, curved, ending in an obtuse point; the pubescence is black. Abdomen long: the second segment slightly broader than the rest; the first and second segments bright fulvous, with yellow pubescence, the remaining segments opaque, black; the third and fourth with a narrow fringe of yellow pubescence on the posterior borders, otherwise the pubescence is black; the under side similar; the hairs on the sides of the abdomen are black on the black segments, on the second segment yellow, with the exception of a tuft of black hairs towards the under side. Legs dark reddish brown, the front ones blacker; all the tarsi pale yellow, the pubescence black, some yellow hairs on the side of the tarsi which are black at their apices; the pulvilli large, the claws long. Wings rich brown in colour, hyaline at the extreme base, and nearly so on the posterior border; the brown becomes fainter at the apex, being most intense round the stigma and in the centre of the wing; veins yellowish brown, the first longitudinal vein black, thickened except at its base.

Halteres yellowish, the knob brown. Length 17 millim.



E S R del

M P Parker lith
Parker & West imp

TRICHORHIZA BRUNNEA

4. On *Trichorhiza*, a new Hydroid Genus.

By E. S. RUSSELL *.

[Received November 11, 1905.]

(Plate V. †)

TRICHORHIZA.

Hydranth solitary, attached loosely by the hydrorhiza, which is filiform and branched. Invested by perisarc, which forms a protective cup into which the hydranth is partly retractile.

The genus *Trichorhiza* is here constituted for a single new species, whose characters are so remarkable as to make the formation of a separate genus for its reception a necessity. The following description of this new species is made from the only specimen which I have seen.

TRICHORHIZA BRUNNEA. (Plate V.)

Trichorhiza brunnea Russell, Abstr. P. Z. S. No. 26, p. 6, Feb. 13, 1906.

Trophosome. Hydrorhiza long and tapering, giving off about half-a-dozen filiform branches along the lower half. The cœnosarc apparently does not extend into this lower half nor into the branches. The perisarc expands above to form a cup, marked by four transverse grooves. Immediately below this cup several longitudinal lines are present on the perisarc. The hydranth is conical upon a moderately long peduncle. Tentacles in two verticils; the proximal filiform, twelve in number, when extended as long as the hydranth, set with numerous rings of nematocysts; the distal capitate, seven in number, and very short. The latter are inserted on the summit of the hypostome, the former near the base of the conical head of the hydranth.

Gonosome. A circlet of 8–10 sessile medusoids, which are developed between the proximal and the distal rows of tentacles and become free.

Dimensions:—

Total length of hydranth	1·5 mm.
Total breadth of hydranth	0·8 mm.
Overall length of hydroid	11·0 mm.

Colours. Perisarc straw-coloured, except that forming the cup, which is chocolate-coloured. Tentacles translucent white. Body of hydranth pale reddish-brown.

Gonophore (at time of liberation). Hemispherical, in systole bell-shaped, slightly contracted in the upper third, and constricted at opening of umbrella-cavity. Exumbrella with a few nematocysts scattered over it. Velum well developed.

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* [The complete account of the new species described in this communication appears here; but since the name and preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—EDITOR.]

† For explanation of the Plate, see p. 101.

Manubrium, when extended, as long as umbrella-cavity, cylindrical, and with narrowed end.

Mouth simple, circular, with a ring of bead-like nematocysts closely surrounding it.

Four ocellar bulbs, ellipsoid: one of these is somewhat larger than the others. Radial canals four, simple.

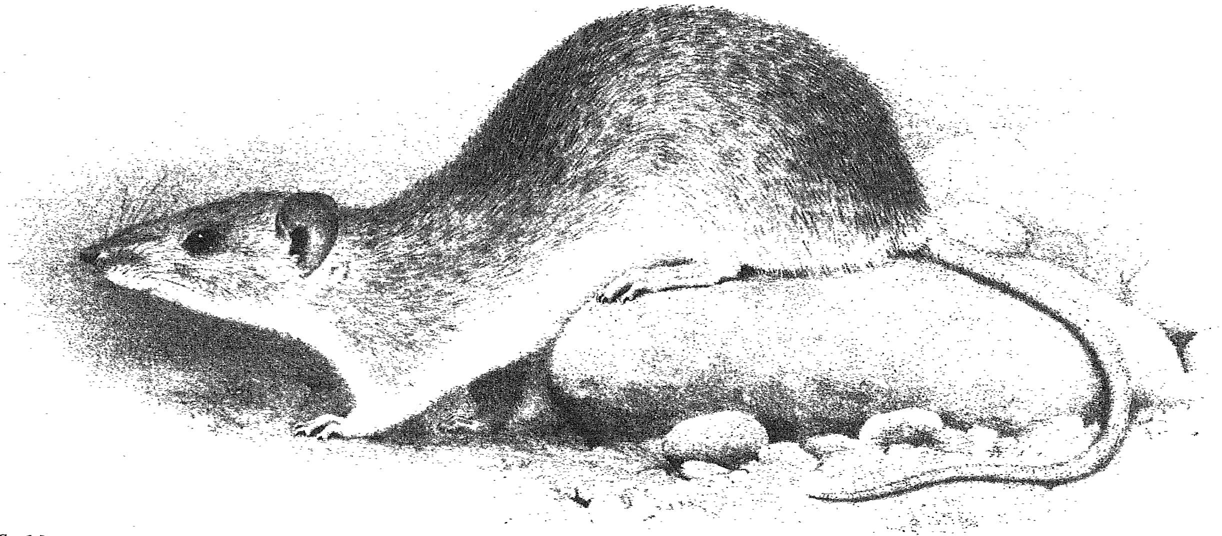
Dimensions. Length of bell 0·8 mm.; breadth of bell 0·7 mm.

Colours. Manubrium tinged with yellow, but very faintly. Ocellar bulbs golden yellow.

The type specimen of *Trichorhiza brunnea* was discovered on June 29th, 1905, clinging to the tentacles of a specimen of *Corymorpha nutans* Sars, dredged in 17 fath. at Ettrick Bay, Bute, Firth of Clyde. The filiform hydrorhiza with its branches was intertwined among the tentacles of the *Corymorpha* so as to be with difficulty unravelled from them. The *Trichorhiza* was kept alive for a day or two at the Millport Marine Biological Station, and gave off on July 1st the medusoid which has been described. It was usually to be seen half-retracted into its protective cup, with the proximal tentacles much contracted, and the distal ones looking like mere knobs. On the rare occasions on which it was observed in an expanded condition, the tentacles of the outer circle were seen to be held rather stiffly extended.

Systematic. On account of its possession of two verticils of tentacles, the proximal filiform and the distal capitate, *Trichorhiza* is to be referred to the family Pennaridæ as constituted by Allman (1). That family contained the following genera:—*Pennaria* Goldfuss, *Halocordyle* Allman, *Stauridium* Dujardin, *Vorticlava* Alder, *Heterostephanus* Allman, *Acharadria* Wright, and *Acaulis* Stimpson.

Two other genera have sometimes been associated with the Pennaridæ, namely *Blastothela* Verrill, which is placed among the Pennaridæ by Delage et Hérouard (3), and *Tiarella* Schulze, which is referred to the same family by G. Herbert Fowler (4). But such an assemblage of genera by no means makes up a homogeneous family. K. C. Schneider (6), in his critical revision of the classification of Hydroids, has removed *Stauridium* to his amended family of the Corynidæ. *Tiarella*, with its three rows of capitate tentacles, has also been referred to this extended family of the Corynidæ by Mme. Motz-Kossowska (5), who follows Schneider's classification in the main. These two genera are rightly separated from the other genera of Pennaridæ, as they have little in common with the Pennarian type. The seven which remain of the nine genera mentioned above are all fairly closely allied to one another. *Halocordyle* certainly must be united with *Pennaria*, and we may with Schneider also bring under *Pennaria* the genera *Vorticlava*, *Acharadria*, *Acaulis*, and *Heterostephanus*. *Heterostephanus* is allied by its medusoid with the *Corymorpha* type. *Blastothela* too



H. Goodchild, del et lith.

Huth, imp.

MUS WOCSNAMI.

(Verrill, 7) resembles *Corymorpha* in its possession of root-like fixing-processes at the base.

From all these genera of the Pennaridæ (*sensu stricto*), however, *Trichorhiza* is separated by the characters of its hydrorhiza, and also by the possession of a sort of theca, comparable to that of a calyptoblast. The branches of the hydrorhiza may be compared with the filamentous processes of the base in *Corymorpha*, but there is no real affinity between the two structures.

The medusoid of *Trichorhiza*, so far as one can judge from an immature specimen, resembles the medusoid of *Pennaria tiarella*, which, however, has no developed tentacles at all (Ayres, 2), while the medusoid of *Trichorhiza* seems to have one tentacle-bulb more developed than the other three, and in this respect approaches to the medusoids of the *Corymorpha*-like forms, most of which bear one developed tentacle.

On the whole, *Trichorhiza* is to be associated with the *Pennaria*-like forms, though the characters of its hydrorhiza and its "theca" give it a somewhat isolated position among them.

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EXPLANATION OF PLATE V.

Fig. 1. *Trichorhiza brunnea*. Hydroid, p. 99.
Fig. 2. *Trichorhiza brunnea*. Medusoid, p. 100.

5. A List of the Mammals obtained by Messrs. R. B. Woosnam and R. E. Dent in Bechuanaland. By Harold Schwann, F.Z.S.

[Received December 15, 1905.]

(Plate VI.*)

This very interesting collection, made by Messrs. R. B. Woosnam and R. E. Dent in Bechuanaland, was obtained chiefly at two localities, viz. Kuruman and Molopo. The former is situated about 100 miles south-west of Vryburg on the Kuruman River, whose course flows parallel to the range of hills bearing the same name. The river was originally fringed with dense reeds, providing excellent shelter for game of all kinds; but in some parts clearings have been made by the natives, and the ground drained and cultivated with corn and fruit-trees.

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* For explanation of the Plate, see p. 111.

The Molopo River, lying considerably to the north of Kuruman, is dry most of the year, but in the rainy season may be as much as 16 feet deep. The water remains in stagnant pools till about mid-August, when it is gradually evaporated, leaving the river-bed dry until next year. The country surrounding the river is covered with dense camel-thorn * forest and patches of soft sand.

The particular interest of this collection lies in its providing the British Museum with many valuable topotypes of Dr. Smith's now well-worn and rather faded specimens. His main collections, described in the 'Illustrated Zoology of South Africa,' were made at Kuruman and Old Latakoo, lying in S. lat. 27°, E. long. 24°, a place not marked on modern maps, but in his day of considerable importance. As was to be expected, the prevailing colour of the specimens is sandy and considerably lighter than that of animals inhabiting well-wooded areas. Among the species now described for the first time may be mentioned *Crocidura deserti*, a pale-coloured Shrew, probably a desert form of Sundevall's *argentata*, and *Mus woosnami*, a striking species both in colour and tooth-structure.

1. RHINOLOPHUS DENTI Thos.

♂. D. 7, 8. Kuruman.

2. RHINOLOPHUS AUGUR K. And.

♂. W. 26, 28, 29; D. 124, 125, 126, 127. ♀. 127. Kuruman.

"I found some hundreds of these Bats hanging on the rocks in the shaft of an old gold-mine near Kuruman fountain. Of the fifteen that I caught, curiously enough, only one was a female. These Bats are common here, but seem to be found only in the caves, as I have seen none about the houses or old mission buildings here."—*R. B. W.*

3. NYCTERIS THEBAICA Geoff.

♂. D. 15. Kuruman.

4. VESPERTILIO CAPENSIS Smith.

♂. D. 133. ♀. W. 56. Kuruman.

"I caught this little brown Bat in an old mission building. It is not an uncommon species here."—*R. B. W.*

5. MINIOPTERUS SCHREIBERSI Kuhl.

♂. W. 30. Kuruman.

"This little black Bat with a very long tail was caught at night in the Cape Police canteen and is the first specimen I have met with."—*R. B. W.*

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* So called from the Dutch name for the Giraffe, "kameelpardel," which is very fond of these bushes.

6. NYCTINOMUS BOCAGEI Seabra.

♂. W. 19. ♀. W. 15; D. 16. Kuruman.

"One of these long-tailed Bats was caught in our room in the old mission buildings. I have seen some before, but it is not a very common species."—*R. B. W.*

7. CROCIDURA DESERTI, sp. n.

♂. W. 87. ♀. W. 83. Molopo.

A pale-coloured Shrew of medium size, probably allied to *C. argentata* Sund.

Fur fine and silky, about 6 mm. in length on the centre of back. General colour of upper surface between "ecru-drab" and "drab-grey," hardly lighter on the flanks. General colour of under surface from chin to anus silvery cream-colour, contrasting with the colour of the sides; the line of division sharply defined. Individual hairs of back slate-grey basally, subterminal ring dull white, tip between walnut-brown and mars-brown. Hairs of belly light grey basally, creamy white terminally. Head coloured like body; snout strongly bifid; ears sparsely covered with minute white hairs; fore and hind limbs and feet pure white. Tail about half the length of the head and body, stoutly built, covered with minute white hairs. The lateral gland is well marked in both the specimens. Second and third unicuspids subequal, about half the size of the first.

Dimensions of the type (measured in the flesh):—Head and body 92 mm.; tail 46; hind foot 14; ear 12.

Skull:—Basal length 22 mm.; anterior breadth 7·6; posterior breadth 10; interorbital breadth 5·5; length of upper tooth-series 10·2; tip of i^1 to tip of p^4 5·4.

Hab. Molopo, west of Morokwen.

Type. Male. B.M. no. 4.10.1.62. Original number 87. Collected 13th July, 1904.

J. W. Grill, who described* the collections made by J. F. Victorin in South Africa, mentions that the type of *C. argentata* was obtained at Roodeval in the Karroo.

"I obtained both these Shrews in the dry bed of the Molopo River, among the long dry grass, in traps baited with dough set in old mole-holes. The owls catch a great many of them, and I think they must be common, but are difficult to get."—*R. B. W.*

8. HERPESTES GALERA Erxl.

♀. W. 47. Kuruman.

"Native name 'Moduba.'

"This Mongoose was trapped in the reeds on the Kuruman River. The natives say there used to be a great many about, but they are now very scarce and hardly ever leave the tall reeds by the river's bank to go on to the veldt. They are said to make a nest of reeds, grass, and sticks, which floats in the middle of the thickest reed-bed. On this they rear their young. Their food consists chiefly of fish, frogs, and crabs."—*R. B. W.*

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* Zool. Anteckn. in Vetensk. Ak. Handl. 1858, ii. p. 16, no. 10.

9. CYNICTIS PENICILLATA LEPTURA Smith.

♂. W. 53. ♀. D. 128. Kuruman.

In view of the close resemblance of the teeth of these specimens to those of the type of Smith's *leptura*[*], and the proximity of Kuruman to the type locality, it seems best to refer them provisionally to that race, although, owing to their immaturity, their identity is rather uncertain. They are, however, smaller and more slenderly built than specimens of the same age from other localities, and it seems probable that a further series from this region would show the existence of a small desert race extending from Kuruman to the northern limit of Bechuanaland. On laying out geographically the British Museum series of *Cynictis* skins for purposes of comparison, the specimens fell naturally into well-marked local races, as was the case with the Suricates described by Mr. Thomas and myself in the second paper[†] dealing with the Rudd exploration of South Africa. The Namaqualand or western race has already been described as *C. penicillata pallidior*[‡], a pale veldt form not found in the low-lying country near the coast. The Great Karroo possesses, as might be expected, a race, peculiar to itself, of a light lemon-yellow colour, described by Smith as *Cynictis ogilbyi*.

The type specimen is still the only example in the British Museum of this subspecies, described by Smith in 1849. The type of *C. steedmanni* Ogilby, obtained at Uitenhage, is indistinguishable from the series collected by Major G. E. H. Barrett-Hamilton at Vredefort Road in the north of the Orange River Colony. It is possible that Steedman, who travelled through the Orange Colony, made a mistake as to the locality of his specimen, or that the race represented by Major Barrett-Hamilton's specimens extends as far south as Uitenhage. The local race inhabiting central Cape Colony, and represented by Mr. Grant's specimens from Deelfontein, appears to need description. It may be called

Cynictis penicillata intensa, subsp. n.,

and is distinguished by the strong tawny ochraceous suffusion on the back, upper surface of hind limbs, and tail. Individual long hairs of back about 25 mm. in length, basal half light buffy yellow, subterminal ring black, tip tawny ochraceous on the middle line, lighter on the flanks. Under-fur dark smoky-brown basally, terminal half ochraceous. General colour of the whole under surface, including fore and hind limbs and tail, between claycolour and ochraceous-buff (Ridgway). Forehead coloured like back. Upper lips and cheeks buffy, profusely grizzled with white. Hind surface of ear mummy-brown. Interramia and throat between buff and cream-buff, with no sign of grey. Tail thick and bushy, the hairs ranging in length from 40 mm. at the base to 60 mm. at the tip, terminal inch creamy buff.

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[*] Smith, Ill. Zool. S. Afr. pl. 17 (1849).

[†] P. Z. S. 1905, vol. i. p. 132.

[‡] P. Z. S. 1904, vol. i. p. 175.

Dimensions of the type (measured in the flesh):—Head and body 367 mm.; tail 261; hind foot 76; ear 41.

Skull:—Greatest length 74 mm.; basal length 67; zygomatic breadth 40; antero-posterior diameter of bulla 19.

Hab. Deelfontein, Cape Colony.

Type. Female. B.M. no. 2.9.1.23. Original number 171. Collected 10th March, 1902, by Mr. C. H. B. Grant, and presented by Col. A. T. Sloggett.

"Native name 'Moshe.'

"These Meerkats were trapped in the bush-veldt. They live in holes, generally in the middle of a 'wait-a-bit' thorn-bush, and are common everywhere. Their food consists chiefly of mice and insects."—*R. B. W.*

10. Pedetes caffer Pall.

♀. W. 18. Kuruman.

"There are a few of these Hares about here, but not so many as I have seen in other places. They never come out till dark to get their food, which consists of grass and roots, though I think they eat locusts and beetles."—*R. B. W.*

11. Graphiurus griselda, sp. n.

♂. W. 48, 49, 66; D. 136, 139. ♀. D. 137. Kuruman.

External proportions as in *G. murinus*; molar teeth intermediate in size between *G. murinus* and *G. nanus* de Wint.

General colour of upper surface uniform olive-grey, the forehead and median line of back indistinctly suffused with blackish. Individual hairs soft and fine, about 10 mm. in length, basal four-fifths blackish slate, terminal fifth light grey. General colour of under surface creamy white, bases of hairs slate-grey. A black marking extends from the origin of the whiskers to behind the eye, surrounding the orbit. Ears distinctly larger than in *G. murinus*, covered with minute hairs. Upper lips, cheeks, and interramia creamy white. Several specimens exhibit the rufous suffusion on the throat and chest frequently found in members of this genus. Upper surface of hands and feet snowy white, the hair covering the claws. Tail subcylindrical, thickly haired, much lighter in colour than the back, the tip white.

Skull similar to *G. murinus* in general proportions, but with slightly larger bullæ and distinctly smaller molars; nasals not extending so far back as the premaxillary processes.

Dimensions of the type (measured in the flesh):—Head and body 92 mm.; tail 78; hind foot 16·5; ear 16.

Skull:—Greatest length 24·5; basal length 20·4; interorbital breadth 5·2; zygomatic breadth 15·0; depth, top of parietal to base of bulla 10·5; brain-case breadth 11·5; nasals 9·6 × 3·4; palate length 8·4; diastema 6·0; length of upper molar series 3·4.

Hab. Kuruman, Bechuanaland.

Type. Male. B.M. no. 4.10.1.14. Original number 66. Collected 26th May, 1904.

This very pretty Dormouse may be distinguished externally from *G. murinus*, to which it is probably most nearly allied, by its olive-grey colour, and from *G. nanus* and *G. smithii* by its larger size and more bushy tail.

"These mice live about 20 feet from the ground in the big trees in the gardens by the river. They are especially fond of willow, seringa, apple, and camel-thorn trees. They are well known by the natives, who call them 'Peba,' but then they call all mice 'Peba' and all rats 'Tebude'."—*R. B. W.*

12. Tatera lobengulæ Thos.

♂. W. 37, 43, 45, 62. ♀. W. 38; D. 5,12,14,140. Kuruman.
♂. W. 78, 80, 82, 96. ♀. W. 79, 81, 97, 98. Molopo.

"This species almost invariably has its burrows in patches of 'wait-a-bit' thorn-bush. I fancy they are preyed upon by the meerkats, as I have seen scores of rats' and mice burrows that have been scratched out by them. These rats move about a great deal and do not stay long in any one burrow."—*R. B. W.*

13. Gerbillus paeba schinzi Noack.

♂. W. 76. Molopo.

This specimen so exactly matches the small series collected by Mr. Andersson in Damaraland, identified by Mr. Thomas with *G. paeba schinzi* Noack, that it seems best to regard it for the present as a member of that subspecies. Schinz collected in Ovampoland up to the edge of the Kalahari desert, and gave an account of his itinerary in the 'Verhandlungen der Gesellschaft für Erdkunde zu Berlin.'* *G. paeba* and its synonym *tenuis* afford an example of Dr. Smith's habit of changing specific names for others that he considered more suitable.

"I have found this species very plentiful wherever I have been in Bechuanaland. These mice are nocturnal, though they are occasionally to be seen on cloudy days."—*R. B. W.*

14. Desmodillus auricularis Smith.

♂. W. 41; D. 143, 144. ♀. W. 23, 24, 31, 61; D. 141. Kuruman.

♀. W. 73. Molopo.

These specimens constitute the first well-preserved series ever obtained of this very interesting animal. The British Museum's previous material consisted of Smith's original example from Namaqualand, now much worn and faded, one specimen taken at

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* 1887, B. xiv. 7, p. 322.

Deelfontein in Central Cape Colony, and five rather dilapidated skins from Otjimbinque in Damaraland. The South African Museum possesses examples from Douglas in Griqualand West*. This species does not occur in the neighbourhood of Cape Town.

"This white-bellied mouse has a white spot behind each ear, and lives in small burrows in open places among the bush. It is not uncommon. After digging one out one day, I dug up many other holes, but only found toads in them."—*R. B. W.*

15. OTOMYS IRRORATUS Brts.

♂. W. 13, 16, 20, 46, 105; D. 6, 145. ♀. W. 14, 106. Kuruman.

♀. W. 69. Setchowane.

Lichtenstein mentions† that the specimen on which Brants founded this species came from the east coast of South Africa. The present series agrees very well with the British Museum specimens from Natal and Pondoland, of which the former may be considered the type locality.

"I found none of these rats on the Molopo River, and I fancy they are only to be found near permanent water."—*R. B. W.*

16. MUS COUCHA Smith.

♂. W. 17, 21; D. 19. ♀. W. 8, 12; D. 13, 17, 20. Kuruman.

These specimens may be taken as topotypes of Smith's *Mus coucha*, described by him as coming from the country "between the Orange River and the Tropic." The male specimen, no. 21, exactly matches his type in the British Museum in colour and general proportions. The Zululand form, which has been recently described‡, may be distinguished from the typical subspecies by its more fulvous coloration, longer tail, and cream-coloured feet.

"These mice were trapped in a fence along the river. I have caught several of them, but the ants nearly always ate the ears off before I arrived. They seem mostly to frequent the water's edge, though they are to be found occasionally in the veldt."—*R. B. W.*

17. MUS AURICOMIS de Wint.

♀. W. 35, 36, 64, 67, 68. Kuruman.

These specimens agree very closely with the series collected by Mr. Darling at Mazoe in Mashonaland, the type locality of de Winton's *auricomis*.

I take this opportunity of describing a local race of this species collected by Mr. C. H. B. Grant at Deelfontein in Cape Colony. It may be called

Mus auricomis centralis, subsp. n.

Similar to the typical subspecies in general proportions and in the colour of the upper surface, but with the belly buff instead of white. The whole of the upper parts buffy yellow strongly suffused with black; cheeks, flanks, and upper surface of hind limbs as far as the ankle-joint pure buff-colour. Individual hairs of dorsal region about 16 mm. in length, basal three-fifths slate-grey, subterminal ring fawn, tip black; the hairs on the flanks without the black tip. Under surface, with the exception of the throat and the inguinal region which are dirty white, bright buffy, the light grey bases of the hairs showing through in places. Tail indistinctly bicolor, covered with fine hair, dark brown above, creamy white below, terminal portion unicoloured light brown, tip with a minute tuft.

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* Mamm. South Afr. 1902, vol. ii. p. 24.

† Darst. Säug. 1827, Taf. xxx.

‡ Thos. & Schw. P. Z. S. 1905, vol. i. p. 268.

Dimensions of the type (measured in the flesh):—Head and body 114 mm.; tail 152; hind foot 24; ear 17.

Skull:—Greatest length 30·3; basilar length 23·4; breadth across brain-case 13·7; zygomatic breadth 14·5; interorbital breath 14·5; nasals 13·4 × 4; palate length 13·0; diastema 8·0; upper molar series 5·5.

Hab. Deelfontein, Cape Colony.

Type. Female. B.M. no. 3.1.4.51. Collected 1st Sept., 1902, by Mr. C. H. B. Grant and presented to the British Museum by Col. A. T. Sloggett.

The buff-coloured belly by which this local race is distinguished from the typical subspecies appears to be a remarkably constant character, all the specimens Mr. Grant collected at Deelfontein possessing it in a striking degree.

"Native name 'Tube.'

"These mice chiefly frequent the tops and slopes of the hills, living in the holes and cracks of the rocks with the dassies. I have never seen this mouse except in the Kuruman hills, where it is fairly plentiful. I do not think it is to be found in the flats below."—*R. B. W.*

18. MUS WOOSNAMI, sp. nov. (Plate VI.)

♂. W. 33, 39, 42, 52; D. 130. ♀. W. 40; D. 131, 134. Kuruman.

♂. W. 86. ♀. W. 101.

A medium-sized species of a pale grey colour with a mammary formula of 3—2 = 10.

General colour of upper surface between "smoke-grey" and "drab-grey" (Ridgway), more or less pencilled with black; flanks considerably lighter, with no black pencilling. Individual hairs of back about 15 mm. in length, basal half "slate-grey," subterminal ring "drab-grey," terminal portion black. Colour of under surface creamy white, the light grey bases of the hair showing through in places. Head coloured like back, occasionally rather lighter; a line extending from the muzzle to the inner side of the fore limb, white. Whiskers soft, fine, and black, about 35 mm. in length. Ears of medium size, oval, the edges covered externally with minute black hairs, internally with white. Upper surface of hands and feet clothed with fine white hair not extending over the claws. Tail shorter than the head and body; covered above and below with short white hair, except on the upper surface for a space of about 10 mm. at the distal end, where it is black; tip not tufted; scale-rings numbering about 33 to 1 cm.: mammæ three pairs pectoral, and 2 pairs inguinal.

Skull smooth and rounded, not ridged. No supraorbital edges, only a faint indication of ridges on the parietals. Anterior edge of anteorbital plate shows considerable variation from strong convexity to being nearly straight. Palatal foramina widely open, of medium length, ending opposite the anterior lamina of m^1; palate ending 0·5 mm. behind m^3. Bullæ of medium size.

Incisors not visible beyond the nasals when viewed from above, orange in the upper jaw, light yellow in the lower. Molars of medium size, broad with well-defined cusps. Anterior median cusp of m^1 larger than the two posterior ones, partly fused with the antero-external cusp. M^3 is a simple circular tooth with one large antero-internal cusp. The simplicity of this tooth is very remarkable and quite different from the typical arrangement found in *M. rattus.*

Dimensions of the type (measured in the flesh):—Head and body 138 mm.; tail 122; hind foot 26·5; ear 20·5.

Skull:—Greatest length 35; basilar length 29·4; zygomatic breadth 17·8; nasals 14 × 3·6; interorbital breadth 4·2; braincase breadth 13; interparietal 4·4 × 9·4; henselion to back of palate 16·3; palatine foramina 7·6; diastema 10; upper molar series 5·7; mandible, height at coronoid 10·7; incisor tips to condyle 24·8.

Hab. Molopo, Bechuanaland.

Type. Male. B.M. no. 4.10.1.83. Original number 86. Collected 13th July, 1904.

This very distinct species is unlike any rat hitherto known, both in colour and in the structure of the third upper molar. I have much pleasure in naming it after Mr. R. B. Woosnam, to whose efforts in company with Mr. R. E. Dent the British Museum is indebted for this very interesting collection.

"These rats from Kuruman were trapped in the bush-veldt about half a mile from the river in the mouth of a small hole in a 'wait-a-bit' thorn-bush. Unfortunately the black ants damaged a good many of the animals in the traps. At Molopo this rat seemed to be confined to the river pools."—*R. B. W.*

19. Mus sp.

♂. D. 132. ♀. D. 141. Kuruman.

♂. W. 74, 75, 84, 89, 22, 93, 100. ♀. W. 85, 90. Molopo.

Owing to the absence of adult females in the series I am unable to ascertain the mammary formula of this animal, a factor of great importance in deciding the specific position of mice in the *Mus coucha* or *colonus* groups.

"These mice are very plentiful among the long dry grass by the Molopo River and in the forest on the banks."—*R. B. W.*

20. LEGGADA MINUTOIDES, Smith.

♂. W. 91, 94. Molopo.

"These mice were taken in the dry bed of the Molopo River, in an old mole run."—*R. B. W.*

21. SACCOSTOMUS HILDÆ, sp. n.

♂. W. 59, 60, 63, 65. ♀. W. 22, 55, 57, 58. Kuruman.

A stoutly-built species, probably allied to *S. mashonæ* de Wint., but smaller and greyer.

Fur long, thick and very fine in texture, about 13 mm. in length on the middle of back. General colour of upper surface smoke-grey pencilled with black, passing to drab-grey on the flanks. Colour of entire under surface from chin to anus, including fore and hind limbs, pure white, sharply defined laterally. Individual hairs of back slate-colour for basal 10 mm., subterminal ring ecru-drab, tips black. Hairs of under surface white to the base, about 8 mm. in length. Tip of muzzle white; whiskers about 30 mm. in length, black with white tips; ears sparsely covered with white hair. Tail short, thick, bicolor, black above, white below.

Skull smaller than in *S. mashonæ*; zygomata more expanded anteriorly, ridges more marked and extending further on to parietals. Antero-external cusp of m^2 intermediate in development between *mashonæ* and *campestris* *.

Dimensions of the type (measured in the flesh):—Head and body 124 mm.; tail 51·5; hind foot 18·5; ear 19.

Skull:—Greatest length 33·5; basilar length 28; greatest breadth 17; nasals 13·8 × 4; interorbital breadth 15; breadth of brain-case 13·5; palatilar † length 16; diastema 9·10; palatal foramina 6·6 × 2·5; upper molar series 4·8.

Hab. Kuruman. Alt. 4000 ft.

Type. Male. B.M. no 4.10.1.49. Original number 63. Collected 22nd May, 1904.

This very well-marked species is distinguishable from *S. mashonæ* by its smaller size and generally lighter colour.

S. campestris and *fuscus* Peters are both smaller species. The former was obtained at Tette on the Zambesi, and the latter, the smallest known member of the genus, was taken at Inhambane. *S. lapidarius* is synonymous with *campestris*, Peters having renamed the species, as he considered the former name more suitable. *S. anderssoni* de Wint., discovered in Damaraland, may be distinguished from all other species by its sandy coloration.

Specimen number 4.10.1.53 possesses an additional minute molar on each side in the upper jaw behind the usual m^3. The teeth in the lower jaw are normal both in size and number. An addition to the molar series of rodents is of such rarity, that an instance of its occurrence seems worthy of record. Dr. Forsyth Major has recorded instances in other orders in a paper published in the 'Proceedings'*.

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* De Wint. P. Z. S. 1896, p. 805.

† Thomas, Proc. Biol. Soc. Wash. vol. xviii. 1905, p. 193.

"Native name 'Koti.'

"These mice were caught in the bush not far from the river. The animal has a pouch on each side of its face, which it fills with seeds, giving it a very curious appearance."—*R. B. W.*

22. Arvicanthis pumilio griquæ Wrought.

♂. W. 7, 9; D. 10, 11. ♀. W. 10, 11, 104; D. 9. Kuruman.

Until the appearance of Mr. R. C. Wroughton's very carefully thought-out paper on the "Various Forms of *Arvicanthis pumilio*"†, I had considered this series to be identical with *A. p. bechuanæ* Thos. It is now, however, abundantly clear that it should be considered a distinct local race.

"These mice are not uncommon on the bush-veldt near the river. They come out a good deal by day."—*R. B. W.*

23. Georychus lugardi de Wint.

♂. W. 102, 103. ♀. W. 95. Molopo, west of Morokwen.

This series exhibits a tendency to prolong the white blaze on the forehead into a dorsal stripe, a characteristic that is wanting in the type of the species. Specimen no. 102 (B.M. no. 4.10.1.89) is remarkable for the abnormal development of the ascending premaxillary processes, which meet in the middle line behind the nasals, thus entirely isolating the latter bones from the frontals.

This condition is, so far as I am aware, unique in the British Museum's very large collection of *Georychi.*

"These specimens were caught in the dry bed of the Molopo River and the sandy veldt some distance from it. The natives told me that all the Moles on the river-banks were like these."—*R. B. W.*

24. Georychus sp.

♀. D. 21. Kuruman.
♀. W. 71. Morokwen.

25. Procavia capensis Pall.

One specimen, unnumbered. Kuruman.

EXPLANATION OF PLATE VI.

Mus woosnami, p. 108.

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[*] P. Z. S. 1904, vol. i. p. 416.

[†] Ann. Mag. Nat. Hist. 1905, ser. 7, vol. xvi. p. 632.

6. On a Central African Ratel and Water-Chevrotain.

By R. Lydekker.

[Received January 6, 1906.]

(Plate VII.*)

I have lately been favoured with the opportunity of inspecting a number of skins and skulls of mammals collected by Major Powell-Cotton in Central Africa, among which two appeared worthy of bringing under the notice of the Society. In a letter sent to Mr. Rowland Ward referring to the localities of the specimens, Major Powell-Cotton states that they were all obtained on the "eastern fringe of the Ituri Forest to a point fifteen miles west of Mawampi and thence south-east to Boni, at elevations of between 2100 and 2950 feet above sea-level."

The first specimen I have to bring to notice is an entirely black Ratel, represented by the skin and skull. The ordinary colouring of the Ratels—grey above and black beneath—is so characteristic not only of both the African and Indian representatives of the group, but also of various allied mustelines, such as the African *Zorilla* and *Pœcilogale* and the American *Galictis*, that it can scarcely be regarded otherwise than as a deeply ingrained attribute of the species in which it occurs, and one connected in some special manner with protective adaptation. Any departure from this type of colouring in animals of the group in question—unless, indeed, it were a mere instance of melanism—would seem therefore to imply an important modification in habits or surroundings. Now—although I have no justification for saying that the present specimen may not come under the category of a mere individual melanism—the conditions prevalent in the great Ituri Forest are manifestly very different from those of the open or bush-clad country in which Ratels are commonly found; and they are, moreover, just the conditions which are conducive to the development of blackness in a species. Accordingly I venture to consider that Major Powell-Cotton's black Ratel very probably represents a distinct species, for which the name *Mellivora cottoni* may be suggested.

An all-pervading blackness, save for a few grizzly or tawny hairs on the upper part of the head, must be regarded as the sole distinctive characteristic of the species, as I can find no points in which the skull can be distinguished from that of the ordinay grey and black African Ratel. Not that this is a matter for wonder, since, so far as I am aware, it is almost impossible to distinguish Indian from African Ratels by their skulls alone, or the fossil Siwalik species from its living Indian representative. In colour, length, and texture of hair the black Ituri Ratel may be likened to a Himalayan Black Bear. If the animal dwells in constant shade, the reason of its departure may not be far to seek, as I have little doubt that the greyness of the upper parts of ordinary Ratels is in some way connected with the play of sunlight upon this aspect. The specimen is represented in Plate VII.

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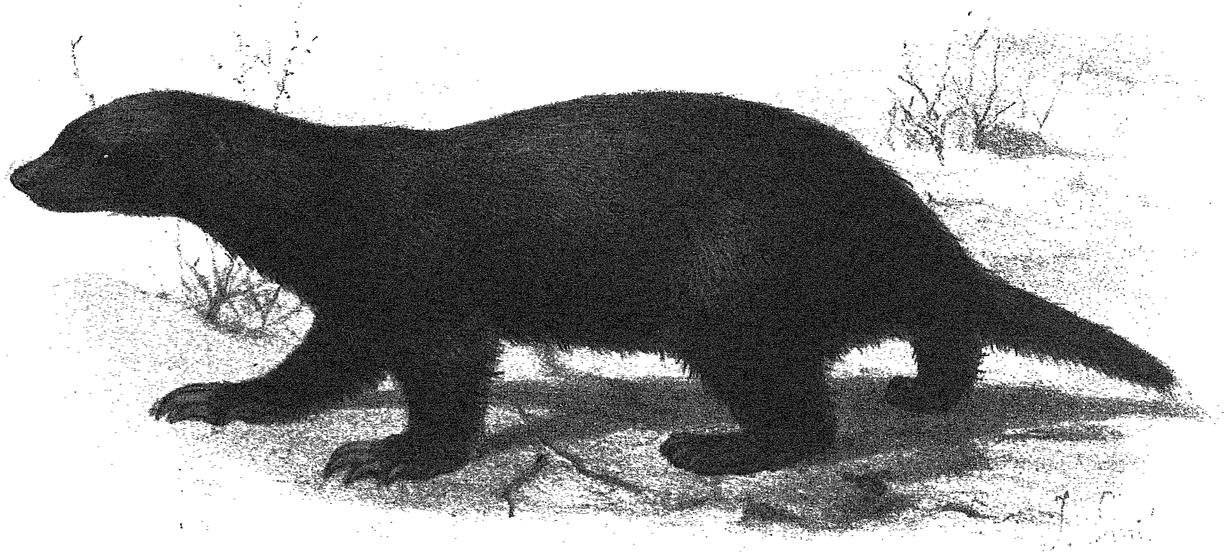
* For explanation of the Plate, see p. 113.



J. Smit del. et lith.

Bale & Danielsson, L^td imp.

THE BLACK ITURI RATEL.
(MELLIVORA COTTONI.)

The second animal is mainly of interest from a geographical standpoint. The African Water-Chevrotain (*Dorcatherium aquaticum*), of which only a single form has hitherto been recognised, is known to inhabit the West Coast from the Gambia to the Cameroons, but does not seem to have been previously recorded from the great Central African Forest, in which it is now demonstrated by Major Powell-Cotton's specimen to exist.

As regards cranial characters, the Ituri Chevrotain presents no points of distinction from West Coast specimens.

Of skins of the latter the Natural History Museum has a very poor series—or rather no series at all,—possessing two skins (one mounted) of the typical Gambian form presented in the "forties" by the then Earl of Derby, and one skin collected in the Cameroons by Mr. G. L. Bates. Unfortunately the tail of the Cameroon specimen is wanting.

The Gambian, Cameroon, and Ituri skins appear to me probably to represent three different races, which may be described and named as follows:—

A. Markings on under surface of chin, throat, and chest white; face uniformly chestnut or nearly so.

a. White markings on back and flanks fully developed; a very distinct white flank-band running from the shoulder along the flanks to join transverse loin-band; two other flank-bands below this; spots on back forming distinct and continuous transverse bands; tail with much brown above.

Dorcatherium aquaticum typicum.
Gambia.

b. Light markings on back and flanks less distinct and less numerous; flank-band yellow instead of white, almost disappearing midway between head and fore limbs; no flank-bands below it; spots on back less distinctly in the form of bands; tail with a very large amount of white, and apparently more bushy than in last.

D. a. cottoni (subsp. nov.).
Ituri Forest.

B. Markings on under surface of chin, throat, and chest yellow; face with a black chevron running from the muzzle to the eyes.

c. Light markings on back in the form of yellowish-white spots anteriorly, but on the loins forming almost continuous yellow bands, arranged alternately on each side of the middle line, where they are interrupted; one distinct yellowish flank-band joining transverse rump-band; tail brown at base, rest unknown.

D. a. batesi (subsp. nov.).
Cameroons.

If the yellow in Mr. Bates's specimen be due to staining, my conclusions will, at least to a certain extent, be wrong.

EXPLANATION OF PLATE VII.

Ituri Black Ratel (*Mellivora cottoni*). From Major Powell-Cotton's specimen.

7. The Articulation of the Vertebrate Jaw.

By H. George F. Spurrell.

[Received February 1, 1906.]

(Text-figures 34–47.)

Consideration of the human skull led me to the belief that the angle of the jaw is contrived to place the temporo-mandibular joint above the level of the teeth. The advantage of this arrangement would be that the lines of the teeth in the upper and lower jaws would be thrown less out of the parallel when the mouth opened and that the teeth would meet simultaneously when the mouth shut, and would all press on food between them with more nearly equal force. Further, it seemed to me that this arrangement favoured, if it was not absolutely necessary to, the antero-posterior and lateral movements of the opposed surfaces of the molars over one another in mastication.

To test the probability of this supposition, I examined the skulls of other animals.

From the numerous mammalian types I separated two:—

I. The type in which the molar teeth are laterally compressed in the long axis of the jaw so as to give it a sharp cutting-edge. In this type the jaw has a very slight angle, if any. A line drawn through the teeth and produced backwards almost cuts the temporo-mandibular joint.

Example, Wolf (text-fig. 34).

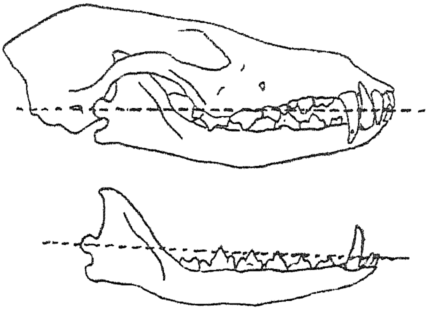
II. That in which the molar teeth have broad flat tops, for grinding vegetable food. In this type the jaw is bent, in some cases almost to a right angle, and the temporo-mandibular joint thus raised well above the level of the teeth.

Example, Hare (text-fig. 35).

Type 1 is the carnivorous type. The molars are required to cut soft stringy flesh and to crack large and very hard objects; therefore the presence of the tuberculated posterior molars and the blade-like carnassial teeth. Roughly speaking, the jaws of a carnivore resemble a combination of nut-crackers and shears: shears because the hinder teeth overlap considerably. Then as the fulcrum is in a straight line behind them, and the mouth is closed by approximating the points A and B, the edges of the back teeth must play on one another successively along their length, like the edges of shears (text-fig. 36).

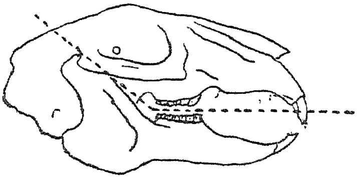
In accordance with this type of dentition and conformation of jaw, a peculiar form of joint is required. Hence the condyle is shaped like a long transverse cylinder (text-fig. 37). It fits closely into a long groove, so deepened by a process of bone behind that it becomes almost tubular. All lateral movement of the jaw is thus rendered impossible, because it is not only unnecessary to the animal but would endanger the working of the shears by allowing their edges to get crossed.

Text-fig. 34.



Skull of Wolf.

Text-fig. 35.



Skull of Hare.

Text-fig. 36.

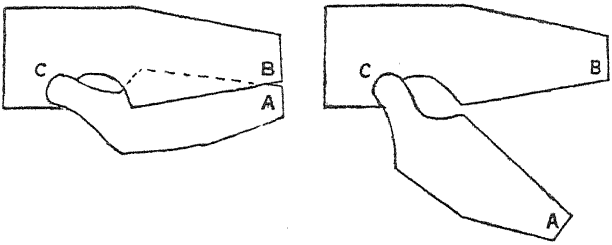
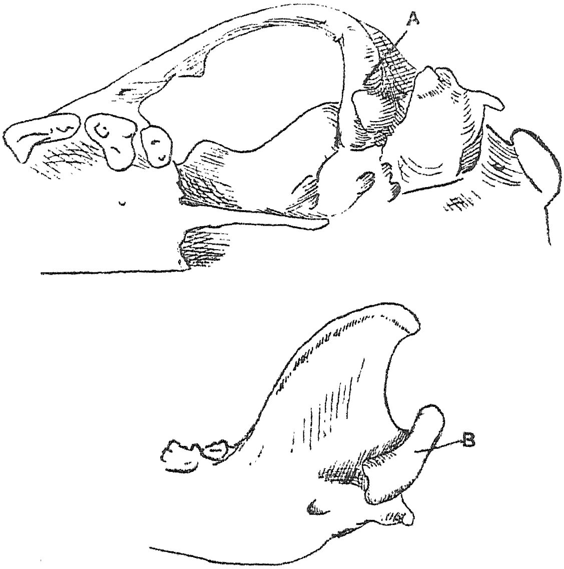


Diagram of jaws. Type 1.

Type 2 is the herbivorous type of jaw. The molars are required to meet simultaneously and to grind with equal force upon the comparatively small morsels of food which have been bitten off for them by the incisors. This they are enabled to do by the angle of the jaw, which places the articulation on a different level from the teeth (text-fig. 38). The closure of the

Text-fig. 37.



Skull of Dog.

A. Glenoid fossa deepened by a process of the squamosal bone.
B. Cylindrical condyle of lower jaw.

Text-fig. 38.

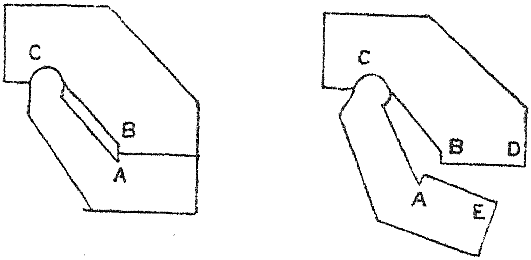


Diagram of jaws. Type 2.

mouth is effected by the approximation of the points A and B (which correspond mechanically to A and B in text-fig. 36, C being the fulcrum in both diagrams).

When the jaws close on an object between them, the pressure is greater between the teeth which are furthest back, near the points A and B, than between the front ones, near the points D and E. But though the pressure at right angles to the level edges of the jaws is not equal in all parts, the oblique forward pressure of the lower jaw on the upper as it slides up underneath it is more nearly equal in proportion as the angle E A C approaches a right angle. The molar teeth of the Hare may be seen to have their flat biting-surfaces set obliquely: those of the upper jaw look downwards and backwards; those of the lower jaw look forwards and upwards. The plane in which they meet simultaneously is at right angles to the line of force (text-fig. 39).

Text-fig. 39.

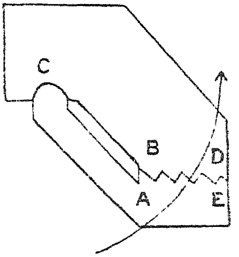


Diagram of jaws. Type 2.
Showing the crowns of the teeth set in a plane at right angles to the greatest pressure.

Text-fig. 40.

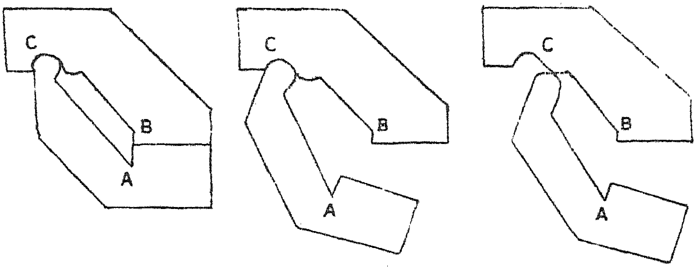


Diagram of jaws. Type 2. Showing the emenentia articularis.

Further, economy of movement is obtained in this type by the condyle of the jaw not only rotating, but also gliding forward on to the eminentia articularis. By this means the point A, at the same time that it is separated from B, is depressed, and thus so wide a gape is not necessitated, and also the parallelism of the teeth, and possibly also the position of the inferior dental foramen, is not so much disturbed (text-fig. 40). The molars are also required to make to-and-fro movements over one another. They have to act as grindstones. The comparative roundness of the condyle, the large extent of the articular surface over which it can play, and the presence of an emenentia articularis on to which it can glide, all contribute to increasing the range of these movements. The structures, moreover, are capable of considerable modification to meet the various requirements of ruminants, rodents, primates, &c.

The mouth in Type 1 has to allow its possessor to seize and hold other animals, and for this reason the wide gape which the type allows is required. First the animal must bring its long canine teeth to bear on its prey; then it must be able to bring its hindmost molars directly to bear on the larger bones and the flesh of the prey. Therefore, in animals of this type, the corners of the mouth extend far back.

Text-fig. 41.

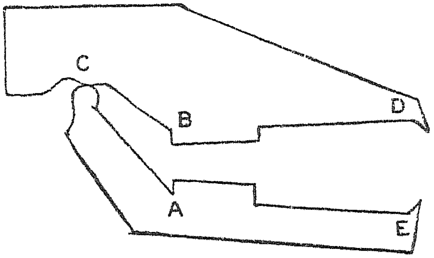


Diagram of jaws. Type 2.

Showing lengthening of the jaws forward in order that the incisors may be widely separated whilst the molars are slightly separated and not thrown much out of the parallel.

The mouth in Type 2 has to allow its possessor to crop grass or gnaw off pieces of roots, &c. These morsels of food are then ground up by the molars. For neither of these purposes is a very wide gape required. A very slight separation of the molars is necessary; but in some animals, particularly the rodents, a rather wider separation of the incisors is required. As the progressive widening from back to front of the gap between the teeth is small when jaws of type 2 are opened, the jaws are often lengthened forwards. This allows the same movement which separates the molars at the back slightly to separate the incisors in front more widely (text-fig. 41). As it is only the incisors, not the molars, which are required to break up large pieces of food outside the mouth, the oral fissure is small. Another reason for this is that the molars require muscular cheeks to help the tongue in placing the food between them.

It is perhaps the difficulty of striking a balance between the proper separation of the molars and incisors which keeps the angle E A C (text-fig. 41) greater than a right angle in animals with incisors. In animals like the Elephant and the Manatee, in which the lips do the work allotted to the incisors of most other herbivora, the angle is far nearer a right angle. The skull of the Dugong (in which horny plates take the place of incisors) seems to attempt another solution of the difficulty. Another angle is introduced into the jaw, bringing the anterior third of the jaws into a line parallel with the ascending ramus (text-fig. 42). A less marked tendency to introduce the second angle may be seen in some other animals:—among the Pigs, in *Sus longirostris*; among the Ruminants, in the Chevrotain *Tragulus javanicus* (text-fig. 43).

Text-fig. 42.

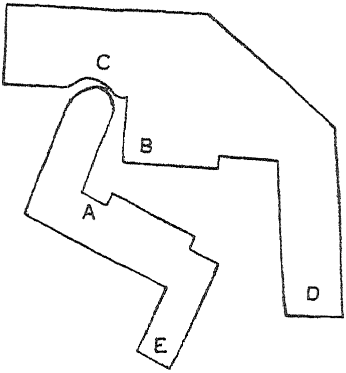
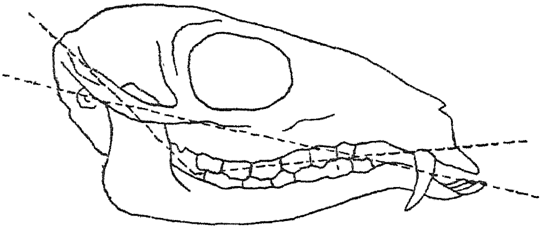


Diagram of jaws. Type 2.

Showing the introduction of a second angle to procure wide separation of the incisors with slight separation of the molars.

Text-fig. 43.



Skull of *Tragulus javanicus*.

Having briefly studied the principle in the Mammals, I next turned to the Reptiles. Most of these have jaws of type 1: the lower jaw articulates with the skull in the plane of the teeth. The Snake, however, has a mouth in which (owing to the great mobility of the quadrate) the jaw-principles of type 1 and type 2 are combined in a very remarkable manner.

The mandible of the snake articulates with the quadrate; the quadrate with the squamosal; and the squamosal with the parietal (text-fig. 44).

When the snake wants either to seize its prey or to strike it with the poison-fangs in its maxillæ, it requires a wide gape. To get this, the movement is made at the quadrato-mandibular joint, which can be placed on a level with the teeth. The jaw-principle is then that of type 1.

Having seized its prey, the snake, to swallow it, has to advance alternately the teeth in the movable maxilla and those in the mandible on either side. To move the teeth parallel with one another, the movement has to be made from the quadrato-squamosal joint, and so raised above the level of the teeth. The jaw-principle is then that of type 2.

The parieto-squamosal joint allows the level of the quadrato-squamosal joint to be slightly lowered and brought forward; that is to say, freer antero-posterior and lateral movements to be made, and the passage between the quadrates to be slightly widened (text-fig. 44).

Text-fig. 44.

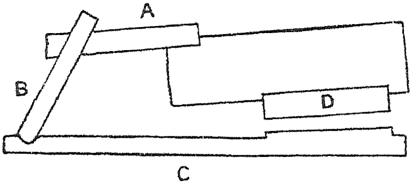


Diagram of Snake's jaws.

A. Squamosal.
B. Quadrate.
C. Mandible.
D. Maxilla.

The mandibles on the two sides are, of course, independent anteriorly.

In most of the reptiles the jaws are of type 1 and are provided with long, sharply pointed and often recurved teeth to prevent the prey from slipping out of the mouth when seized *. These characters of the teeth are particularly well marked in a beast with a short muzzle, *e. g.* the Ceratosaurus. Long teeth are for obvious reasons less necessary in a beast with a long muzzle like the Gavial. The wavy line of the jaws in short-nosed Crocodiles is another device by which the slippings of prey are to be avoided.

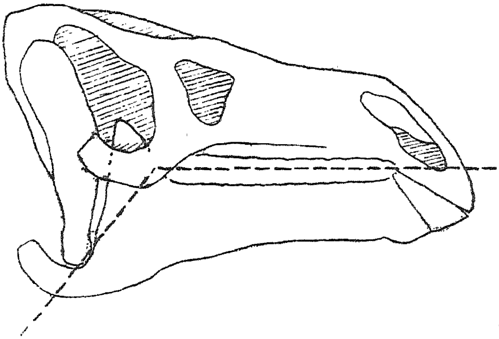
In the Iguanodon, however, the "teeth are not infrequently found worn down at the crown, like the molar teeth of the herbivorous mammalia at the present day" (British Museum Catalogue). "The worn down crowns form cutting, and at the same time crushing, almost triturating surfaces, indicating that these animals lived upon herbs" (Gadow).

---

* I have seen this accident happen. I gave an Ocellated Lizard a large slug which was very slimy and must have been as tough as india-rubber. The lizard picked it up and tried to bite it in half as though it were an earthworm, with the result that the slug shot out of its mouth to the distance of some inches.

In the Iguanodon the quadrate is greatly lengthened so as to place the quadrato-mandibular joint below the level of the teeth (text-fig. 45). In this creature the jaw-principle is therefore type 2, only the reptilian form is the mammalian form turned upside down.

Text-fig. 45.



Skull of *Iguanodon bernissartensis* (teeth not shown in the diagram).

Text-fig. 46.

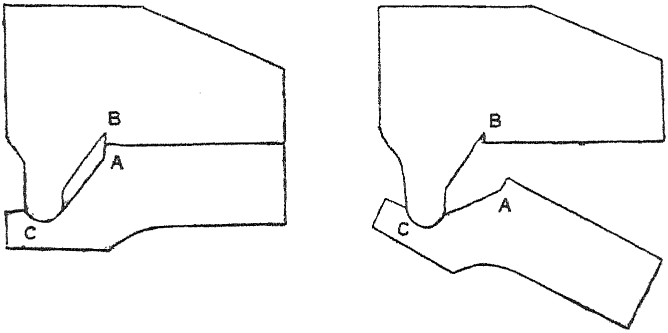


Diagram of jaws. Type 2 R.

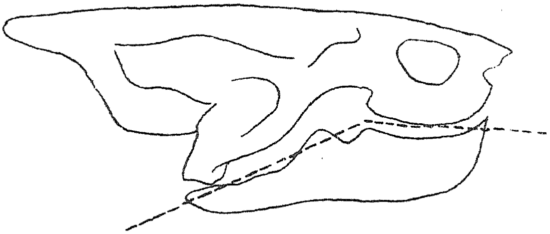
I shall for convenience refer to this type as type 2 R (text-fig. 46).

I have not been able as yet to examine any of these skulls closely, and I do not know whether the quadrato-mandibular joint would allow a slight amount of horizontal movement to the teeth or not.

Type 2 R is also to be seen in a slight degree in some Tortoises (text-fig. 47).

From these investigations I am inclined to believe that animals which have flat-topped molar teeth, for crushing or grinding food, require a jaw mechanism which will allow them to separate the lines of their teeth slightly without throwing them greatly out of the parallel, and then to bring the opposed surfaces of these teeth together simultaneously; and that this requirement is met by articulating the lower jaw with the skull on a plane either above or below that of the opposed surfaces of the teeth. Further, I think that such an arrangement is favourable, if not necessary, to horizontal movements of the teeth over one another.

Text-fig. 47.



Skull of a *Batagur* Tortoise.

Some Inferences.

So far I have been dealing with the subject from a purely mechanical point of view. It is, however, extremely tempting to speculate upon its evolutionary aspects also. I append a few suggestions; but they are, of course, purely tentative.

I regard jaws of type 1 as the original type, and those of type 2 as a later improvement. I think there is ground for this view not only in the fact that type 1 is simpler and the form found in the lower vertebrates, but also in the development of the human jaw. At birth the angle is slight, the condyle being at a low level. As the molar teeth develop from before backwards the angle approaches a right angle, the condyle rising. Also as an abnormality teeth sometimes appear which continue the series of teeth backwards up the ascending ramus of the jaw.

If jaws of type 1 preceded jaws of type 2, the first terrestrial vertebrates were probably animal-food eaters. They probably left the water to prey upon the invertebrates, which were flourishing on the land plants, and in course of time they learnt to eat the more succulent fruits. Some modern lizards, which in general appearance and usual habits are animal-food eaters, will vary their diet by eating a little ripe fruit occasionally.

From soft fruits some of the reptiles passed on to fleshy leaves, but it is doubtful whether they got much further. Owing to the big quadrate bone they could not develop jaws of type 2, so remained rather restricted in their diet. A few only developed jaws of type 2 R; crushing rather than grinding machines.

It was left to the Mammals to develop jaws of the true type 2, and so to be able to achieve easy horizontal movements of the teeth over one another, by which they could grind seeds and reap the highest benefits of a vegetarian diet.

The Birds solved the difficulty of triturating vegetable food by improving their gizzards, not their mouths.

The development of the higher Carnivora was a consequence of the development of the Herbivora. The modern jaws of type 1, with their tuberculated posterior molars, their overlapping carnassial teeth, and their long canines, are as perfect machines of their own kind as jaws of type 2.

The failure of the Reptiles was perhaps due, among other things, to their inability to produce types with jaws capable of effective grinding movements. They were unable to make the most of vegetable foods, and hence were restricted to the parts of the world where the more luxuriant forms of vegetation were found.

February 20, 1906.

G. A. Boulenger, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in January 1906:—

The registered additions to the Society's Menagerie during the month of January were 220 in number. Of these 34 were acquired by presentation and 73 by purchase, 112 were received on deposit, and 1 was born in the Gardens. The total number of departures during the same period, by death and removals, was 208.

Amongst the additions special attention may be directed to:—

A Snow-Leopard (*Felis uncia*), from Ladak; presented by Major A. H. Hussey, R.H.A., on January 22nd.

An Aard Wolf (*Proteles cristatus*), from South Africa; purchased on January 23rd.

A Salt-Marsh Cavy (*Dolichotis salinicola*), from the Argentine, new to the Collection, deposited on January 23rd.

The Secretary read the following extract from a letter addressed to him by Maj.-Gen. Sir Reginald Talbot, K.C.B., Governor of Victoria:—

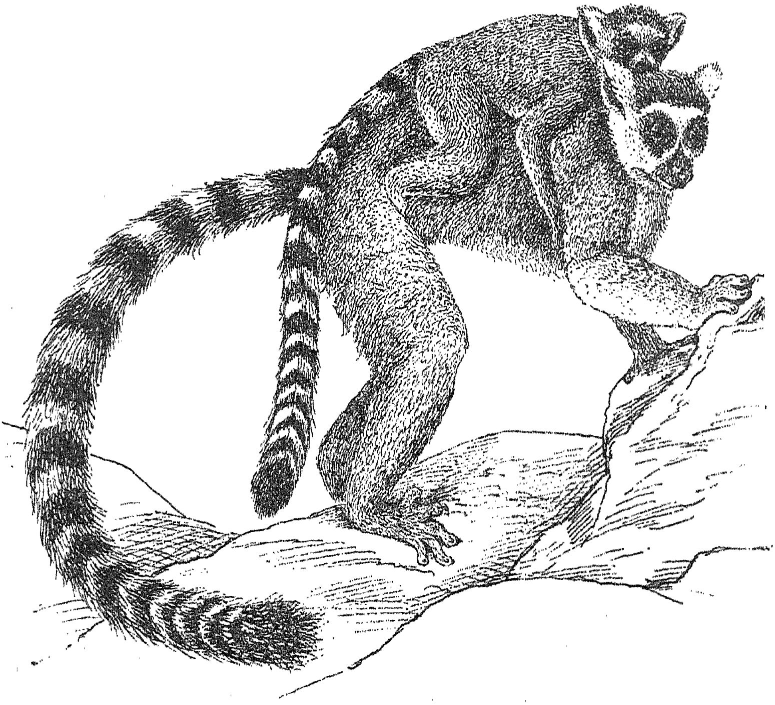
"It may interest the Zoological Society of London to be informed of a well-authenticated case of a Mule giving birth to a foal.

"I enclose an extract from the 'Australasian' of Dec. 30th, 1905, giving a portrait of this mule and foal photographed by Captain Buxton of my Staff. I have myself seen the pair, and there is a striking resemblance between the mule and foal, with light-coloured muzzle and a light-coloured ring round the eyes. The fact of this mule giving birth to this foal and of having suckled her admits of no doubt. Mr. M'Gilp, the Manager of the Carriewerloo Estate, informed me that there was no other mare in foal on his property, and therefore it could not have been adopted by the mule mare as was suggested as a possibility. The only question is whether the sire was a Jack ass or a 2 yrs. old cast Stallion.

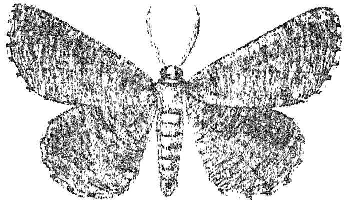
"There has already been some correspondence about this incident in the 'Australasian,' and a letter appeared on Oct. 14th from 'Bruni,' the Naturalist Correspondent who had previously expressed doubts on the subject, but when seeing the animals was convinced that they were mother and foal."

Mr. R. I. Pocock, F.Z.S., the Superintendent of the Gardens, exhibited the photograph of a Ring-tailed Lemur (*Lemur catta*), belonging to Mr. W. S. Gilbert, F.Z.S., to illustrate the method of riding on the back of the mother adopted by the half-grown

Text-fig. 48.



Ring-tailed Lemur and young.



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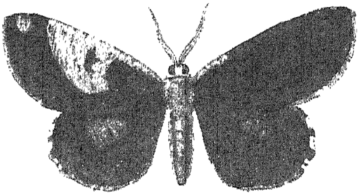

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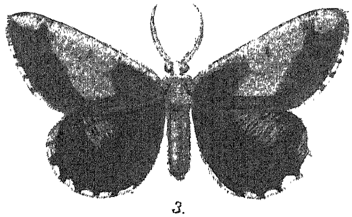

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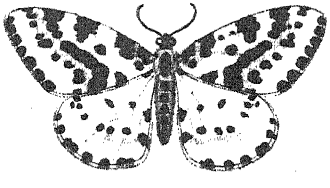

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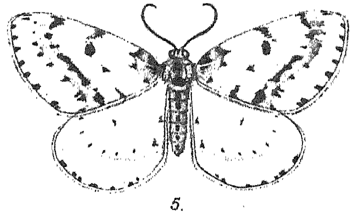

5.

Edwin Wilson, Cambridge

FIGS. 1-3. ANGERONA PRUNARIA AND VAR. SORDIATA.
FIGS. 4, 5. ABRAXAS GROSSULARIATA AND VAR. LACTICOLOR.

young (see text-fig. 48). The little Lemur was born while the parents were in Mr. Gilbert's possession. The pair were turned out into a garden in the first week of July 1905 and left out until the 24th of that month; and Mr. Gilbert was inclined to believe that the mating took place during this period of freedom. However that may be, the young one was born on Sept. 26th; and if Mr. Gilbert's surmise as regards the time of pairing be correct, the period of gestation may be estimated as between ten and twelve weeks.

For the first two months of its existence the little one clung to its mother's breast. It afterwards transferred itself to her back, as shown in the photograph, which represents the animal when 20 weeks old, or about half-grown. Towards the end of January (that is to say, when some four months old) the young one began to go about on its own account, always returning, however, to its mother's back when disturbed by anyone entering the room. By the middle of February it was partly weaned, and was feeding readily upon bananas and milk.

Dr. A. Smith Woodward, F.R.S., F.Z.S., exhibited a new drawing of the skeleton of the Triassic Rhynchocephalian, *Rhynchosaurus articeps*, from the Keuper Sandstone of Shropshire. He pointed out the differences between this ancient reptile and the modern *Sphenodon*, especially noting the great expansion of its coracoids and ischia, and the probably diminutive size of its sternum. He inferred from the everted rims of the upwardly-turned orbits, and from the sigmoidal bend of the femur, that *Rhynchosaurus* was to a great degree aquatic in habit.

The following papers were read:—

1. On Breeding Experiments with Lepidoptera. By L. Doncaster, M.A., F.Z.S., Mackinnon Student of the Royal Society, and the Rev. G. H. Raynor, M.A., F.E.S.

[Received December 28, 1905.]

(Plate VIII.*)

I.—Angerona prunaria. (Plate VIII. fig. 1.)

(Experiments by L. Doncaster.)

In the summer of 1903 I began breeding-experiments with *Angerona prunaria* and its var. *sordiata*, in order to find out how the two forms behaved in inheritance. My material was obtained from two sources: pupæ of both varieties were bought from a dealer, and Mr. C. P. Pickett of Leyton gave me eggs which he had bred. In neither case did I know the ancestry of the insects used. Only three of these original pairings gave larvæ which reached maturity. Their results are given in Table I.

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* For explanation of the Plate, see p. 133.

TABLE I.

No. of Exp.	♀ PARENT.	♂ PARENT.	OFFSPRING.
03.3...	♀ *sordiata* ×	♂ *sordiata*	gave 22 *sordiata* ♂, 25 *sordiata* ♀.
03.6...	♀ *prunaria* ×	♂ *sordiata*	„ 27 *sordiata* ♂, 7 *sordiata* ♀, 1 *prunaria* ♀.
03.4...	♀ *prunaria* ×	♂ *prunaria*	„ 27 *prunaria* ♂, 1 *sordiata* ♂, 40 *prunaria* ♀.

These figures immediately suggested that the banded var. *sordiata* was a simple Mendelian dominant over the unbanded *prunaria* type. The next year's work confirmed this conclusion; and it must be supposed that the single *prunaria* among the offspring of 03.6 and the single *sordiata* in 03.4 were due to accident. The larvæ, when they first hatch, are exceedingly minute, and when the food is changed it is difficult to be certain that no larva clings to the hands and gets transferred to the wrong box.

An inspection of the moths from 03.3 showed that about half of them have the brown bands on the wings, with plain orange or yellow centres, but that the other half, in addition to the banding, have the orange centres speckled as in the typical *prunaria*. Sometimes the speckling is very faint, so that it is hard to give exact numbers of each type, but approximately among the offspring of 03.3 the numbers are 24 speckled and 23 plain. In 03.6 all were speckled. This suggests that the speckled character of *prunaria* is dominant over the plain of *sordiata* at the same time that the banding of the latter dominates over its absence in the former; in this way a heterozygote can be distinguished from a pure *sordiata*.

In 1904, 36 pairings were made, of which 24 yielded imagos in 1905. Their results are given in Tables II.–VII.

TABLE II.—*Prunaria* ♀ × *prunaria* ♂.

No. of. Exp.	*prun.* ♂.	*prun.* ♀.	*sord.* ♂.	*sord.* ♀.
04. 1	8	2	1	...
2	15	8	...	...
3	1	...	...	...
4	11	5	...	...
10	7	6	...	...
12	3	1	...	...
13	...	4	...	...
Total	45	26	1	...

Table III.—*Prunaria* ♀ × speckled *sordiata* ♂.

No. of Exp.	♀ Parent.		♂ Parent.	Offspring.			
				prun. ♂.	*prun.* ♀.	speck. *sord.* ♂.	speck. *sord.* ♀.
04. 8	*prun.* ♀ ex 03.4	×	speck. *sord.* ♂ ex 03.6	10	11	5	5
11	„ „	×	„ „	27	24	16	23
15	„ „	×	„ „	1	0	1	1
17	„ „	×	„ ex 03.3	10	10	6	7
26	„ „	×	„ „	25	30	23	23
			Total	73	75	51	59

Table IV.—Speckled *sordiata* ♀ × *prunaria* ♂.

No. of Exp.	♀ Parent.		♂ Parent.	Offspring.			
				prun. ♂.	*prun.* ♀.	speck. *sord.* ♂.	speck. *sord.* ♀.
04.19	♀ speck. *sord.* ex 03.3	×	♂ *prun.* ex 03.4	2	1	4	4
27	„ ex 03.6	×	„ „	1	0	2	0
			Total	3	1	6	4

Table V.—Speckled *sordiata* ♀ × ♂.

No. of Exp.	♀ Parent.		♂ Parent.	Offspring.					
				prun. ♂.	*prun.* ♀.	plain *sord.* ♂.	plain *sord.* ♀.	speck. *sord.* ♂.	speck. *sord.* ♀.
04.21	♀ ex 03.6	×	♂ ex 03.3	2	1	...	...	...	1
22	„	×	„	...	1	3	2	3	...
25	♀ ex 03.3	×	„	...	...	...	1	1	...
32	„	×	„	...	...	1	...	...	1
			Total	2	2	4	3	4	2

TABLE VI.—Plain *sordiata* × *prunaria.*

No. of Exp.	♀ PARENT.		♂ PARENT.	OFFSPRING.	
				speck. *sord.* ♂.	speck. *sord.* ♀.
04.20	♀ pl. *sord.* ex 03.3	×	♂ *prun.* ex 03.4	8	5
34	,, ,,	×	,, ,,	1	3
28	♀ *prun.* ex 03.4	×	♂ pl. *sord.* ex 03.3	5	3
			Total	14	11

TABLE VII.—Speckled *sordiata* × plain *sordiata.*

No. of Exp.	♀ PARENT.		♂ PARENT.	OFFSPRING.			
				plain *sord.* ♂.	plain *sord.* ♀.	speck. *sord.* ♂.	speck. *sord.* ♀.
04.23	♀ spec. ex 03.3	×	♂ plain ex 03.3	2	...	...	...
33	,, ,,	×	,, ,,	5	2	6	3
35	,, ,,	×	,, ,,	4	...	1	1
			Total	11	2	7	4

From these tables I think it is sufficiently clear that the banding of the *sordiata* is dominant over its absence in *prunaria*, but that the speckling of *prunaria* is at the same time dominant over the plain orange of the pure *sordiata*, giving a heterozygote which is both banded and speckled (Pl. VIII. fig. 2). The plain *sordiata*, however, may have some specks along the wing-rays, so that an exact determination of the numbers of "plain" and "speckled" is not possible. The numbers of these two classes in the tables are therefore approximate.

The numbers are not sufficiently large to show whether the different types occur in the proportions demanded by Mendel's Law, with the exception of those in Table III. Here there are 148 *prunaria* to 110 *sordiata*, where equality is expected; but the mortality is so great among the young larvæ, and also during hibernation, that a very small differential mortality will account for this.

The work was partly undertaken to find out whether there was any tendency for a correlation of either of the types with one or other of the sexes, but no evidence whatever of this has appeared.

It is important to notice that no intermediates occurred; in fact the darkest *prunaria* bred were from two *prunaria* parents, and the lightest *sordiata* from *sordiata* parents.

It may be pointed out that this case is so like what is known of some other instances of alternative inheritance in moths, *e. g.* in *Amphidasis betularia* and its var. *doubledayaria*, that it will probably be found that these also are simple cases of Mendelian inheritance.

II.—ABRAXAS GROSSULARIATA.

(Experiments by the Rev. G. H. Raynor.)

We now turn to the case of *Abraxas grossulariata* and its var. *lacticolor* (*flavofasciata*). Mr. Raynor obtained, some years ago, a rare variety of the female, in which the black markings are very much reduced and assume a partially linear form. They are also characterised by their indefiniteness of outline; instead of the sharp edge to the black marks which is characteristic of the type, in var. *lacticolor* the black spots have an indefinite appearance, which makes them appear to have been put on with a nearly dry brush. The only exception to this rule is the spot in the centre of the fore wing, which is more conspicuous than in the type (see Pl. VIII. figs. 4 & 5). The var. *lacticolor* may therefore be regarded as resembling an albino, in which the black pigment is reduced to a constant extent, but not quite absent. The yellow bands do not differ from those of the type. It should be mentioned that the amount of black varies very widely in the type, but at its most extreme reduction the insect does not resemble *lacticolor*, since the spots are small and definite. Among the many thousand insects bred by Mr. Raynor, no intermediate between *lacticolor* and the type has occurred.

When the original *lacticolor* ♀ was paired with a normal ♂, all the offspring were normal. When, however, two of the progeny of such matings were paired together, some of the female offspring were *lacticolor*, but the var. did not occur among the males (Table VIII.). A number of such families were reared which are not included in the tables, since the numbers were at first not recorded. It appeared, however, that the var. *lacticolor* is a Mendelian recessive of quite a new type, since it was known only in the female, and more exact experiments were undertaken to investigate it further.

In 1903, in addition to pairings of the type DR × DR (first crosses paired together), *lacticolor* ♀s were paired with heterozygous ♂s (see Table IX.). The result of these matings was that *lacticolor* appeared in both sexes, some of the ♂s and some ♀s being *lacticolor*, others of each sex normal. Some of the males used as fathers in these experiments were first crosses, others were heterozygous males of the second generation, which had *lacticolor* sisters. One F_2 male (exp. xliv. '03), which had two *lacticolor* grandparents, when paired with a *lacticolor* ♀ had only normal offspring, showing that in F_2 pure dominant males occur, in addition to heterozygotes, as is expected on the Mendelian theory.

It was now shown that the recessive variety hitherto known in the female only could be transferred to the male by pairing a heterozygous male with a recessive female. It remained to pair male and female of the variety together, and to pair the recessive male with the heterozygous female. Both these pairings were effected in 1904 and repeated in 1905.

Lacticolor ♀ × ♂ (Table XI.) have given exclusively *lacticolor* offspring, male and female; the recessive character breeds true, as was expected.

Lacticolor ♂ × heterozygous ♀ (Table X.) have given all the males normal, all the females *lacticolor*; a result which may have important bearing on the theory of the determination of sex.

To sum up—

DR ♀ × DR ♂ gives DD ♂, DR ♂, DR ♀, RR ♀.
R ♀ × DR ♂ ,, DR ♂, RR ♂, DR ♀, RR ♀.
DR ♀ × R ♂ ,, DR ♂ ... ... RR ♀.
R ♀ × R ♂ ,, ... R ♂ ... R ♀.

Table VIII.—Heterozygous ♀ × heterozygous ♂.
(Type DR × DR.)

No. of Exp.	*gross.* ♂.	*gross.* ♀.	*lact.* ♂.	*lact.* ♀.	Total.
03. xii. ...	25	14	...	9	48
03. xxi. ...	22	9	...	11	42
04. x. ...	13	1	...	15	29
L.D. 04. ii. ...	7	1	...	4	12
Total...	67	25	...	39	131

Table IX.—*Lacticolor* ♀ × heterozygous ♂.
(Type R ♀ × DR ♂.)

No. of Exp.	*gross.* ♂.	*gross.* ♀.	*lact.* ♂.	*lact.* ♀.	Total.
03. iv. ...	...	...	3	...	3
03. viii. ...	10	4	6	2	22
04. v. ...	18	6	11	1	36
Total...	28	10	20	3	61

TABLE X.—Heterozygous ♀ × *lacticolor* ♂.
(Type DR ♀ × R ♂.)

No. of Exp.	*gross.* ♂.	*gross.* ♀.	*lact.* ♂.	*lact.* ♀.	Total.
04. xi. ...	16	...	..	8	24
04. xxxvii. ...	3	...	...	1	4
04. ii. ...	10	...	...	2	12
Total.	29	.	...	11	40

TABLE XI.—*Lacticolor* ♀ × *lacticolor* ♂. (Type R ♀ × R ♂.)

No. of Exp.	*gross.* ♂.	*gross.* ♀.	*lact.* ♂.	*lact.* ♀.	Total.
04. i. ..	...	.	4	1	5
05. ii. ...	...	...	2	5	7
04. viii. ..	...	..	5	7	12
Total .	...	...	11	13	24

It will be noticed that while the results given in the tables are qualitatively in full agreement with Mendel's Law, yet the numbers depart widely from Mendelian expectation. There is always great mortality in rearing insects, especially in those species which hibernate in the larval state, and the discrepancy is probably accounted for by the greater strength and healthiness of *lacticolor*, which we have frequently noted, and which has doubtless caused a selective mortality in favour of the variety as compared with the type.

The following tentative hypothesis is put forward to account for the relations between the variety *lacticolor* and the sexes.

Castle * has suggested that the determinants for the two sexes are segregated from one another in gametogenesis like Mendelian characters, and that a male-bearing spermatozoon always meets a female-bearing egg or *vice versâ*, so that in respect of sex all zygotes are heterozygous. He has further supposed that somatic characters may occasionally be coupled with one or other sex-determinant, so that of the gametes produced by a heterozygote AB, the male-bearing may all carry one somatic character A, while the female-bearing carry its allelomorph B.

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* Castle, "Heredity of Sex," Bull. Mus. Zool. Harvard, xi. no. 4, 1903, pp. 189, 208.

This hypothesis, with slight modification, leads to the results observed in the cross *grossulariata* × *lacticolor*. If we suppose that among the eggs the male-bearing all carry *grossulariata*, the female-bearing all *lacticolor*, while in the spermatozoa there is no coupling, so that we have male- and female-bearing of both kinds, we shall get the following results:

DR ♀ gives eggs D ♂, R ♀.
DR ♂ gives spermatozoa D ♂, R ♂, D ♀, R ♀.

Since in fertilization a male-bearing gamete must always meet a female-bearing, the possible combinations of egg and spermatozoa are as follows:—

(*a*) Egg D ♂ × sperm. D ♀ = zygote DD ♂ ♀.
,, D ♂ × ,, R ♀ = ,, DR ♂ ♀.
,, R ♀ × ,, D ♂ = ,, DR ♀ ♂.
,, R ♀ × ,, R ♂ = ,, RR ♀ ♂.

In the combination *lacticolor* ♀ × heterozygous ♂ we shall similarly have eggs R ♂, R ♀, spermatozoa D ♂, R ♂, D ♀, R ♀ giving combinations—

(*b*) Egg R ♂ × sperm. D ♀ = zygote DR ♂ ♀.
,, R ♂ × ,, R ♀ = ,, RR ♂ ♀.
,, R ♀ × ,, D ♂ = ,, DR ♀ ♂.
,, R ♀ × ,, R ♂ = ,, RR ♀ ♂.

In the mating heterozygous ♀ × *lacticolor* ♂ the eggs are D ♂, R ♀, the spermatozoa R ♂, R ♀, the combinations

(*c*) Egg D ♂ × sperm. R ♀ = zygote DR ♂ ♀.
,, R ♀ × ,, R ♂ = ,, RR ♀ ♂.

It is now obvious that if the sex borne by the egg is uniformly dominant over that carried by the spermatozoon, the results are exactly in accordance with the observed phenomena. The sex carried by the egg is that written first in the zygote columns, and we get—

In group (*a*) DD ♂, DR ♂, DR ♀, RR ♀.
,, (*b*) DR ♂, RR ♂, DR ♀, RR ♀.
,, (*c*) DR ♂ ... ... RR ♀.

It is possible to get the same result in other ways, *e. g.* by assuming coupling between the two characters and the respective sex-determinants in both eggs and spermatozoa and random conjugation between them; but in any case, if Castle's assumption of coupling be taken for granted, it is necessary to assume that it is always the egg which determines the sex.

NOTE.—The sex-hypothesis here outlined seems at first sight to be at variance with that propounded by Wilson (Journ. Exp.

Zool. vol. ii. p. 543)*, and based on his work on chromosomes. We may suppose, however, the two "idiochromosomes" (or "heterotropic chromosomes") in the female before reduction to bear the male and female sex-determinants respectively, while in the male the female-bearing chromosome is reduced or absent. Then in the female we shall have segregation of the sex-determinants at the maturation-divisions, and we may suppose that female-bearing eggs are fertilized by male-bearing spermatozoa, giving females, the male-bearing egg being fertilized by the spermatozoon which has no "heterotropic" chromosome. This is in full accord with the hypothesis suggested by the behaviour of the var. *lacticolor*†.

EXPLANATION OF PLATE VIII.

Fig. 1. *Angerona prunaria*, ♂: p. 125.
2. Heterozygote *prunaria* × *sordiata*, ♂: p. 128.
3. Pure var. *sordiata*, ♂: p. 128.
4. *Abraxas grossulariata*, ♀: p. 129.
5. Var. *lacticolor*, ♀: p. 129.

2. Contributions to the Osteology of Birds.—Part VIII.‡ The "Tracheophone" Passeres; with Remarks on Families allied thereto. By W. P. Pycraft, F.Z.S., A.L.S., &c.

[Received December 28, 1905.]

(Text-figures 49–52.)

i. Introductory Remarks.

In the following pages I have endeavoured to describe the main features of the Osteology of the Tracheophone Passeres; and, further, I have striven to embrace in these remarks such other anatomical facts as may seem to bear trustworthy evidence as to the systematic position of the group.

The "Tracheophoneæ" seem to form a natural group, allied on the one hand to the Eurylæmidæ, Cotingidæ, and Philepittidæ, and on the other to the Tyrannidæ and Pittidæ: details on this point will be found later (p. 158).

This paper is by no means so complete as I could have wished, inasmuch as many genera yet remain to be examined. The position ascribed to some of these at the present day is open to grave suspicion; but these doubts cannot be set at rest until skeletons and birds in spirit are sent home in place of skins.

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* Also 'Science,' xxii. 1905, p. 500.

† Since this paper was written, Wilson has suggested an explanation of his results identical with that outlined here (Journ. Exp. Zool. vol. iii., Feb. 1906).

‡ For Part VII. see P. Z. S. 1905, vol. ii. p. 30.

ii. THE SKULL OF THE ADULT.

The skulls of the types which form the subject of this paper present no striking peculiarities or extremes of specialisation such as are met with among the Eurylæmidæ. Yet collectively they conform to one general plan distinguishable from that of the Tyrannidæ and the forms which appear to me to be allied thereto. This plan, and the modifications thereof, I hope to be able to describe in the near future.

The skulls of the Tracheophone Passeres, and the forms herewith associated, are to be distinguished from those of the Tyrannidæ, Pittidæ, and Philepittidæ mainly on account of the absence of an ossified nasal septum; but besides these there are other small characters, or combinations of characters, too subtle for tabulation, but which nevertheless contribute towards the delimitation of the several groups. Taken separately, however, the skulls of the types herein described can readily be distinguished from those of the Tyranniform types. But, as will be shown in the sequel, the arrangement I here propose does not rest on these characters alone.

The following are the characters which distinguish the families which come within the scope of the present paper:—

Pipridæ.—With a nasal hinge; inflated antorbital plates; a free lachrymal; maxillo-palatine xiphoid; vomer short and broad; postorbital process obsolete; processus zygomaticus spine-like and blunt; interorbital septum perforated.

Formicariidæ.—With anterior nares enclosed by a bony wall, leaving a wide aperture at the proximal end of the nasal fossa between the premaxillary and descending processes of the nasal. Maxillo-palatines strap-shaped, crossing the hinder end of the olfactory fossa, and passing backwards beyond the level of the median, descending plate of the palatine; vomer long and broad; postorbital process large, sometimes joining the processus squamosi; interorbital septum perforate.

Dendrocolaptidæ.—Interorbital septum imperforate; nostrils occasionally of Formicaroid type; postorbital process small; maxillo-palatines short and broad, crossing the hinder end of the olfactory fossa and terminating immediately in front of the descending plate of the palatine; vomer short.

Synallaxidæ.—Nostrils schizorhinal; interorbital septum perforate; maxillo-palatine of great length and slenderness and continued backwards to or beyond the level of the free end of the median descending plate of the palatine.

Conopophagidæ.—Interorbital septum wanting; postorbital processes wanting; maxillo-palatines long, narrow, and angulated, continued backwards to the level of the median descending plate of the palatine.

Hylactidæ.—Interorbital septum perforate; postorbital processes small, placed low down on side of skull; maxillo-palatine long and slender; vomer short, long limbs.

Pittidæ.—Interorbital septum perforate; postorbital processes small; temporal fossa extending to the mid-dorsal line; a more or less well-marked nasal hinge; maxillo-palatines in the form of short thick spurs, crossing the middle of the olfactory floor and far removed from the median descending keel of the palatine.

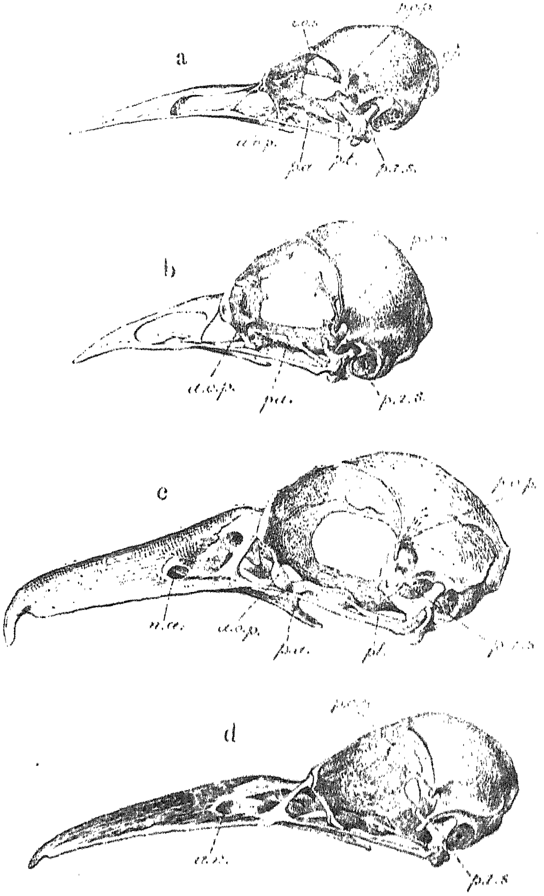
The Occipital Region.

The plane of the occipital foramen slopes obliquely backwards through an angle of about 45°, while the foramen itself is without any marked supraforaminal ridge, except in the case of the Pittidæ, where it is fairly pronounced. Compared with that of the Eurylæmidæ the cerebral fossa will be found to project slightly beyond (caudad of) the foramen, instead of sloping forwards as in that group, thereby indicating a larger brain-cavity. The lambdoidal crest is not strongly marked, but the region enclosed thereby is wide, except in the case of *Pitta*, where this ridge is conspicuous and curves rapidly downwards to pass into the lateral occipital wings, thus decreasing the width of the skull in this region. The cerebellar dome is nowhere very prominent, except in *Pseudocolaptes*, where it attains a development far exceeding that which obtains in any other member of any of the families now under discussion, inasmuch as it rises upwards far above the level of the lambdoidal ridge and temporal fossæ to form a tumid swelling, bounded on either side by the cerebral lobes, which stand out in the form of bullæ separated from the cerebellar prominence by deep depressions. The lateral occipital wings bounding the tympanic cavity are turned somewhat forwards, and tend to approach one another in the middle line more than in the Eurylæmidæ. This is especially noticeable in the Conopophagidæ, Philepittidæ, Pipridæ, and Dendrocolaptidæ.

The Cranial Roof (text-fig. 49 **a**-**d**).—The cerebral dome is wide, well rounded, and rises gently above the cerebellar dome. *Pitta* and *Hylactes* are exceptions in this respect, the cerebral dome rising much higher than in any other members of the families under discussion. In *Pitta* this dome is constricted laterally by wide though shallow temporal fossæ, but in *Hylactes* this region of the skull is full and round, and the temporal fossa confined to a shallow depression immediately above the squamosal prominence. In *Synallaxis*, *Cinclodes*, and *Pseudocolaptes*, among the Synallaxinæ, and to a less extent in *Xiphocolaptes* among the Dendrocolaptinæ, the cerebral dome is very markedly depressed, though it is at the same time unusually broad from side to side. The cranium of *Pseudocolaptes* is further noteworthy in that the roof is marked by a relatively deep median groove, and two lateral grooves marking what answers, more or less accurately, to the Sylvian fissure of the brain (text-fig. 50 **g**, p. 140). In the Pteroptochidæ the form of the cerebral hemispheres is well defined, but the lateral grooves of the "Sylvian fissure" are very faintly indicated.

The interorbital region is narrow, except in *Homorus* and *Xiphocolaptes*, where it may almost be described as broad. In all cases this region expands above and behind the antorbital plates to form a protecting roof for the front of the orbit. Lachrymals, even when present, contribute nothing towards the formation of this protection (see p. 138).

Text-fig. 49.



Lateral aspect of the skulls of:—a. *Pseudocolaptes boissineauti*. b. *Hylactes megapodius*. c. *Batara cinereus*. d. *Dendrocolaptes picumnus*.

a.n. = anterior nares. *a.o.p.* = antorbital process. *c.p.* = cerebellar prominence. *i.o.s.* = interorbital septum. *n.a.* = anterior nares. *pa.* = palatal. *p.o.p.* = posterior orbital process. *pt.* = pterygoid. *p.z.s.* = processus zygomaticus squamosi.

The frontals pass insensibly forwards into the nasals, except in

Pipra, where they are abruptly truncated to form, with the beak, a nasal hinge. In this, as indeed in all other characters of the skull, the Pipridæ agree with the Cotingidæ, and should probably be included therewith; and the Cotingidæ in turn agree in this point with the Eurylæmidæ. There is an incipient nasal hinge in the Pittidæ.

The Base of the Skull.

Basipterygoid processes are absent. The basitemporal plate, except in Pittidæ, is somewhat swollen, and does not extend forward on to the parasphenoidal rostrum, but is bounded by a gently curved or slightly pointed anterior border, the edge of which has fused with the rostrum, leaving apertures for the Eustachian tube. In *Pitta* this plate is slightly concave, pointed anteriorly, and has a free edge. *Xiphorhynchus* appears to be unique, in that from the anterior border of the basitemporal plate just ventrad of the position usually occupied by the basipterygoid processes it exhibits a pair of long needle-like splints of bone immediately under the pterygoid and extending some distance beyond them, almost, in fact, reaching the long spine-like spurs of the palatines (transpalatines, Parker). Only in *Pseudosisura* (*Homorus*) is there any vestige of similar processes, and these take the form of minute prickles.

The *occipital condyle* is very small, spherical, looks downwards and backwards, and lies within a deep precondylar fossa.

The Lateral Aspect of the Cranium.

The *tympanic cavity* is small and bounded above by the base of a more or less well-developed *processus articularis squamosi*, behind by the lateral occipital wing, and below by the external free edge of the basitemporal plate, while in front it is shut in by the quadrate. Of the usual apertures to be found within this cavity the *recessus tympanicus anterior* is the largest.

The superior tympanic recess opens in the Conopophagidæ, Pipridæ, Dendrocolaptinæ, and Synallaxinæ by a moderately large aperture between the otic and squamosal heads of the quadrate; while within the lower segment of this aperture there will be found a cribriform plate leading into the *recessus tympanicus posterior*. In the Pittidæ, Philepittidæ, Conopophagidæ, and Formicariinæ these two apertures are separated by a long bar. The fenestral recess opens at the end of the bony column dividing the anterior and posterior tympanic recesses.

The periphery of the tympanic recess presents characters of sufficient interest to deserve a brief survey.

In the Pittidæ, Conopophagidæ, Formicariidæ, and Dendrocolaptinæ the free edge of the lateral occipital wing rises upwards and forwards to pass into a large depressed *processus zygomaticus squamosi*, and is continued downwards, forwards, and upwards to form a bony wall apposed to the shaft of the quadrate and terminating at the free end of a more or less well-marked *processus articularis squamosi*. In the Synallaxinæ and the Conopophagidæ, however, this wing comes to a sudden stop when it reaches the summit of the curve, then turns abruptly downwards in the form of a sharp ridge, losing itself in the *processus articularis squamosi* (text-fig. 49 b, p. 136).

The *postorbital region* is by no means uniform in character. In the Pittidæ alone wide but shallow temporal fossæ meet to form a narrow sagittal crest. In the Conopophagidæ, the Formicariidæ, and Dendrocolaptidæ (text-fig. 50 b–d, p. 140) temporal fossæ are sufficiently deep to form a fairly conspicuous squamosal prominence, but they do not meet as in the Pittidæ. In the Philepittidæ these depressions are barely traceable.

The postorbital process is obsolete in the Acanthisittidæ, Pteroptochinæ, and Philepittidæ, and in some of the small Dendrocolaptinæ (e. g., *Xiphorhynchus*). In some Formicariinæ (e. g., *Thamnophilus*) and in some Synallaxinæ (e. g., *Synallaxis*) this process is continued downwards to fuse with the zygomatic process of the squamosal, forming thereby a bony bar across the temporal fossa.

The *lachrymal* is either altogether wanting or is vestigial. In the Pipridæ this bone is small, dumbbell shaped, and pressed against the outer border of the swollen antorbital plate as in the Cotingidæ. It lacks an orbital process, lies entirely within the lachrymo-nasal fossa, and is perforated by a pneumatic foramen. In the Pteroptochinæ it has almost completely fused with the antorbital plate and is sigmoidally curved. In the Philepittidæ it is represented only by a minute nodule of bone lying in the superior angle of the lachrymo-nasal fossa and adherent to the antorbital plate.

The Ethmoidal Region.—The interorbital septum is complete only in the Dendrocolaptinæ. The *antorbital plate* does not present any very striking changes of form. In the Pteroptochinæ the ventral border of this plate is deeply notched: its outer border convex and produced downwards at its inferior angle into a small spur resting on the quadrato-jugal bar: in the Philepittidæ it is hamulate in shape. The head of the hammer is large, inflated, projects downwards below the level of the quadrato-jugal bar into which it fits by a groove, while the shaft of the hammer is attached at right angles to the mesethmoid and so as to have a clear space above and below it. In the Pipridæ it resembles that of the Cotingidæ—as might be supposed. Oblong in shape, its dorsal border is sinuously curved, leading into a space between itself and the frontals, its inferior border is straight, but the line is broken by the downward extension of the infero-external angle; the outer free border is hollowed. In Pittidæ the dorsal, external, and ventral borders are fairly deeply hollowed, so that the plate has a bilobed appearance, and this shape is still more pronounced in the Dendrocolaptinæ. In the Formicariinæ this plate is almost quadrangular in form, and has the infero-external angle produced into a long pillar extending down the quadrato-jugal bar: in the larger forms (e. g., *Batara*) this column appears to spring from the middle of the inferior border. In the

Synallaxinæ and Xenicidæ it forms a large quadrangular plate slightly hollowed along its external border.

The floor of the olfactory chamber appears only in a few cases to be partially ossified. Thus, in *Xiphocolaptes albicollis* for example, and possibly in other species of this genus, the anterior portion of the chamber is partly closed in, when the skull is seen from below, by the inward extension of the palatal processes of the premaxilla.

The Premaxilla and Nasal.

Except in the Dendrocolaptidæ and Formicariidæ, the premaxilla presents no really distinctive characters, being but a small, pointed, triradiate bone. In the Dendrocolaptidæ, however, it is often produced, as in *Xiphorhynchus*, into a long, decurved probe. In the species in question this portion of the beak is of considerable length, subcircular, and rod-like. As a consequence of this modification, the anterior nares have shifted backwards so as to lie immediately in front of the lachrymo-nasal fossa, and have become reduced to small oval apertures.

The nasals in such genera as I have been enabled to examine of the Furnariinæ, Synallaxinæ, and Philydorinæ, of Dr. Sharpe's 'Hand-list,' are of the schizorhinal type (text-fig. 50 **g**, p. 150). And on this account, as well as on the evidence of the skeleton generally, I suspect that it will be found advisable, on further work, to merge all three in a single subfamily, and with these will probably follow also the Sclerurinæ, Margarornithinæ, and Glyphorhynchinæ.

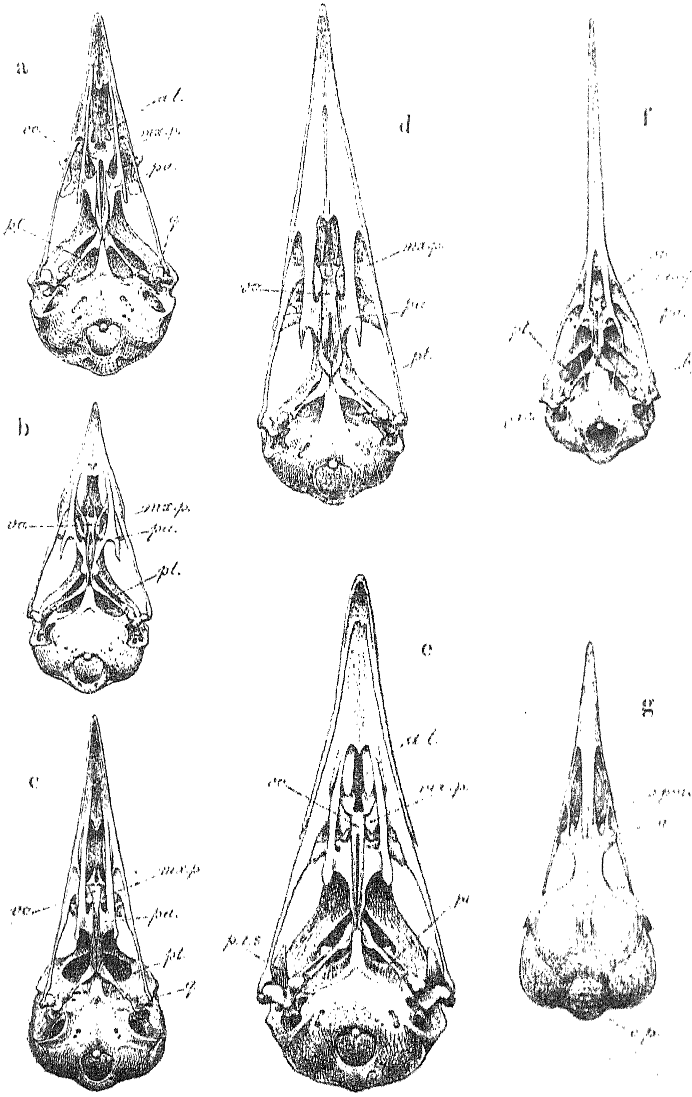
The Maxillo-Jugal Arch.

The maxilla, as usual, is completely fused with the premaxilla, but its approximate size may be measured, generally, by the antero-posterior extent of the maxillo-palatine processes. These differ somewhat markedly in the different groups here associated. They will be found in what is probably their most primitive form in the Pittidæ, Conopophagidæ, Formicariidæ, and Dendrocolaptinæ. Herein the maxillo-palatine process is triangular in form, the apex of the triangle rising gently from a broad base which sweeps round posteriorly into the quadrato-jugal bar. The apex, it should be mentioned, underlies the free end of the vomer. In the Formicariidæ the maxilla, at the point from which the palatine process leaves, is pierced by pneumatic foramina.

In the Pipridæ these processes are strap-shaped, with a pedate free end, and stand out almost at right angles to the long axis of the maxilla. Into the base of this bone there opens a pneumatic foramen conspicuous when the skull is seen from below. The form and arrangement of these elements recall the maxillo-palatines of the Cotingidæ, indeed the differences between the two are a negligible quantity.

In the Conopophagidæ and the Philepittidæ these processes are of considerable length and slenderness. They spring, in the

Text-fig. 50.



Ventral aspects of the skulls of:—a. *Hylactes megapodius.* b. *Philepitta jala.* c. *Pseudocolaptes boissineauti.* d. *Dendrocolaptes picumnus.* e. *Batara cinerea.* f. *Xiphorhynchus trochilirostris.* g. Dorsal aspect of skull of *Pseudocolaptes* (c).

a.t.=concha vestibuli. *b.p.* = basipterygoid process. *c.p.* = cerebellar prominence. *mx.p.* = maxillo-palatine process. *n.* = nasal. *n.pmx.* = nasal process of premaxilla. *pa.* = palatine. *pt.* = pterygoid. *p.z.s.* = processus zygomaticus squamosi. *q.* = quadrate. *vo.* = vomer.

Philepittidæ (text-fig. 50 **b**), from a moderately broad base and slope obliquely backwards till they reach the vomer, when they curve so that their free ends run parallel with the long axis of the skull. In the Pteroptochinæ these processes appear to spring from the inner extremity of the quadrato-jugal bar, that is to say they are given off by the extreme postero-internal angle of the maxilla, instead of springing from the middle of this bone as in the Philepittidæ. They curve backwards and inwards till they reach the vomer, when they turn sharply backwards and run parallel therewith, terminating only when they touch the downward keel of the palatine.

In the Synallaxinæ and Acanthosittidæ these processes are of great length and slenderness, curved towards the middle line, slightly wider at their free ends, and extending backwards so as to meet the median descending keel of the palatines. In *Pseudocolaptes* (text-fig. 50 **c**) the palatine processes of the maxilla may be taken to represent a halfway stage between those of the Dendrocolaptinæ on the one hand, and the specialised form which they present in the Synallaxinæ as a rule. Arising from a broad base they take the form of a pair of tongue-shaped laminæ, underlying the middle of the vomer and presenting a convex border forwards, and a deeply concave border directed towards the palatines, with the median and downward keel of which they come in contact.

The quadrato-jugal bar affords no matter for comment.

The Vomer, Pterygoid, and Palatine.

The vomer (text-fig. 50 **a**–**f**) appears to have preserved its simplest form in the Formicariidæ. Here, as in *Thamnophilus* and *Batara* (text-fig. 50 **e**), it is wide and truncated anteriorly, has a long and broad body, and terminates in two moderately long limbs, which will probably be found, in the nestling skull, to extend backwards to meet the pterygoid.

In the Pittidæ the vomer is of considerable size. Deeply notched anteriorly, it extends backwards for a considerable distance, a moderately long body giving place eventually to a pair of long limbs. Though relatively narrower, the vomer of the Pipridæ is of the same shape. In the Conopophagidæ it is relatively shorter and produced anteriorly into a pair of long "horns," due to the fusion and ossification of the concha vestibuli (text-fig. 50 **a**). In the Pteroptochinæ these adjuncts to the vomer are of great size and terminate in semiossified cartilage. But the body of the vomer is here greatly shortened, so much so that the breadth is greater than the length, and from this abbreviated base two long limbs run back to fuse with the dorsal lamina of the palatines: though it is evident, from the great length of the hemipterygoid element, that in young skulls this vomer and the pterygoid will be found in actual contact. In the Philepittidæ (text-fig. 50 **b**), the vomer, though of considerable length, is extremely reduced laterally, a small feeble body being continued backwards by a pair of slender, almost filiform limbs. In the Dendrocolaptinæ (text-fig. 50 d, p. 140) and Synallaxinæ it is much reduced, the body being short and broad, and the limbs only moderately long. Anteriorly, as in the Conopophagidæ, it supports ossifications of the turbinal cartilage. In some of the Synallaxinæ, e. g. *Pseudocolaptes*, these ossifications take the form of a small pair of triangular plates set vertically.

The *pterygoid* has a straight and more or less cylindrical shaft, and extends far forward on to the parasphenoidal rostrum; and as a consequence of this forward position the basipterygoid processes have disappeared, and the facets for articulation therewith have completely disappeared from this rod.

As might be expected, there are some few exceptions to the general rule among these groups as to the form of the shaft. Thus in *Pseudocolaptes* the inner aspect of this rod has developed a broad phalange increasing in breadth from the proximal third forwards to the palatine, while in *Acanthidositta* it is strongly bowed forwards. But the pneumatic aperture which occurs near the articulation for the quadrate in the Eurylæmidæ appears to be wanting altogether in the types now under consideration except in the Pipridæ. The chief point of interest which attaches to this bone here concerns the form and relations of its distal extremity. In the Pipridæ, as in the smaller Cotingidæ, this shaft terminates in a long, hastate plate closely applied to the parasphenoidal rostrum, and fused along its inferior border with the palatine. The Pteroptochidæ at first sight appear also to agree in this matter, but a more careful examination shows that the expanded, hastate portion (hemipterygoid) is cut off by an almost vertical section from the shaft, and appears as though it were but an upgrowth of the dorsal edge of the palatine. *Hylactes* differs from the rest of the Conopophagidæ in this only, that the suture between the main shaft and the hemipterygoid is more oblique.

In the Pittidæ the shaft extends further forward, and terminates some distance in front of and above the end of the palatine, in a roughly quadrangular plate, deeply notched in front. With this plate the hemipterygoid forms what may almost be described as a dove-tailed joint fitting into the notch just described, and running backwards below the expanded end of the pterygoid shaft as far as the end of the palatine with which it is fused.

In the Philepittidæ there is no hemipterygoid, the shaft being continued forwards from the point where it meets the palatines in the form of a long and delicate sword-shaped blade, curving slightly upwards. The free end of this blade reaches the vomer, which, however, is fused with the palatine.

The Formicariinæ, Dendrocolaptinæ, and Synallaxinæ agree exactly with the Pipridæ and the smaller Cotingidæ. The Acanthosittinæ, however, are quite peculiar in this matter, but nearly resemble the true Passeres. The shaft, which is sigmoidally curved, ends in a small pedate plate closely applied to the parasphenoidal rostrum and passes over, and beyond, the hinder ends of the palatine for some considerable distance, so that what appears to be the hemipterygoid lies immediately under the pedate expansion of the main shaft of the pterygoid.

The differences which obtain among these groups in the matter of the palato-pterygoid articulation are of sufficient interest to demand some further notice. I have shown that the Pipridæ, Pteroptochinæ, Formicariinæ, Dendrocolaptinæ, and Synallaxinæ all agree in common with the smaller Cotingidæ, while the Philepittidæ markedly differ therefrom.

Now among the Cotingidæ this palato-pterygoid articulation appears under three forms. In what is doubtless the most primitive the shaft of the pterygoid is continued forwards, precisely as in the Philepittidæ (p. 142); and this is well seen in *Chasmorhynchus* for example, and, in a slightly more specialised form, in *Calyptomena* among the Eurylæmidæ. In Cotingids, such as *Aulia* or *Lathria*, we have apparently the intermediate stage between that seen in *Philepitta* and *Chasmorhynchus* on the one hand, and that of the smaller Cotingids, such as *Hadrostomus*, and the Formicariinæ—and the types associated therewith in this connection—on the other. In this intermediate stage the pterygoid impinges against the parasphenoidal rostrum, and is then continued forward in the form of a pedate plate, articulating with what is evidently a large hemipterygoid fused with the palatine, by means of a sinuous joint. In the smaller Cotingids, and in types such as *Thamnophilus* and *Pteroptochus*, this joint has become obliterated by anchylosis.

I cannot recall a similar fusion between pterygoid and palatine in any of the higher Passerines, but it occurs with some frequency among the Coraciiform birds, as, for example, in the Capitonidæ and Bucconidæ.

The *palatine* has a scroll-shaped body turned with its concavity inwards, and, fusing with the hemipterygoid, forms an articular surface whereby it is enabled to glide backwards and forwards along the parasphenoidal rostrum. The ventral free edge of the scroll forms, with that of the opposite palatine, a deep channel along the roof of the palate immediately behind the vomer. From the outer convex surface of this scroll there is given off, near its anterior border, a narrow horizontal lamina, which sends a short spur backwards to form the transpalatine process (W. K. Parker) and a long, slender rod forwards to fuse with the palatine process of the premaxilla. Except in the Pittidæ, the maxillo-palatine processes lie so far back that their free ends touch, or almost touch, the antero-inferior angle of this palatine scroll; but in the group in question these processes have shifted forwards so that their free ends are far removed from any relation with this portion of the palatine. The transpalatine spur is especially long in *Xiphorhynchus* (text-fig. 50, *f*, p. 140), and this is apparently correlated with the remarkable form of the beak.

The Quadrate.—As in the Eurylæmidæ, though not in so marked a manner, the quadrate develops a columnar buttress of bone lateral of the outer condyle, for the articulation of the quadrato-jugal bar; and this column, in the Conopophagidæ, rises upwards parallel with the shaft of the quadrate and for half its height. The outside of this column is gently hollowed to form an articular surface for the quadrato-jugal bar, the extreme proximal end of which rises gently upwards to slide along the glenoid surface prepared for it. When the quadrate is seen from in front, the outer condyle, for the articulation of the mandible, has the appearance of being borne on a separate pedicle standing out obliquely and at some distance from the inner condyle, and this is especially marked in the Synallaxine forms. Seen from its articular surface, the inner condyle will be found to be subcircular in shape and separated by a deep gorge from the outer condyle, which is oblong, sigmoidally curved, and has its long axis almost at right angles to the long axis of the skull. These features, it may be remembered, obtain also in the Eurylæmidæ and Cotingidæ.

The Mandible.

The *mandible* does not present any very striking characters, or points of value for systematic purposes.

It is truncated posteriorly and has only a very short internal angular process, except in the Conopophagidæ, where it is of moderate length. The lateral vacuity is always very small, and may be altogether wanting, as in the Pittidæ, Pipridæ, Philepittidæ, and some Dendrocolaptinæ. The symphysis is nowhere extensive except in the case of long-billed forms, such as *Xiphorhynchus* for example, wherein the rami rapidly approach one another to form a long, slender, curved rod flattened along its superior surface.

iii. THE VERTEBRAL COLUMN.

The presynsacral vertebræ are all heterocœlous and free.

In their general characters the cervical vertebræ agree very closely with those of the Eurylæmidæ, which I have already described.

The odontoid ligament of the atlas is ossified in all the groups here dealt with. Hypapophyses are well developed only in some Formicariinæ (e.g. *Batara*), the Dendrocolaptinæ, and Synallaxinæ. As in the Eurylæmidæ, the typical number of cervicals is twelve; following these are three cervico-thoracic vertebræ, *i.e.* those bearing free ribs which do not articulate with the sternum. The hindmost pair bear uncinate processes but have no sternal segment. In some, e.g. *Synallaxis*, there are only two pairs of cervico-thoracic vertebræ, the hindmost pair just referred to in such cases articulate with the sternum. But this point is of no systematic value, though of interest morphologically.

The thoracic vertebræ are six in number and have well-developed quadrangular neural spines, which may, as in Pipridæ form a series of separate upstanding plates, or may, on the other hand, interlock one with another by means of a bifurcating process from the anterior and posterior angles of the dorsal border. In a skeleton of *Siptornis* sp. inc. three of these vertebræ (1–3) have become anchylosed, but whether this is an individual peculiarity or is a feature peculiar to the genus I am at present unable to say.

The last thoracic, in all the species of the groups here dealt with, has fused with the synsacrum, and in the Dendrocolaptinæ two thoracics appear to be generally fused therewith, each of which bears long ribs (see p. 146). Hypapophyses in the Pittidæ are wanting; in no case is there more than two of these processes. In the Hylactinæ and Dendrocolaptinæ they are fairly well developed, but never so long as those of the two cervico-thoracic vertebræ immediately preceding. In the Pipridæ and Philepittidæ they are degenerate. *Philepitta*, by the way, is remarkable for the small size of the centra.

Twelve vertebræ enter into the composition of the synsacrum, but the series from which these are drawn is not always the same, as may be seen by the following tables:—

	Pitta.	Pipridæ.	Conopophagidæ, e. g., *Hylactes.*	Philepittidæ.
Thoracic	1	1	1	1
Lumbar	2	2	2	3
Lumbo-sacral ...	3	3	3	3
Sacral	2 [caudal.	2	2	2
Caudal	4+7 free	3+8	3+8	3+8
	12	11	11	12
	Total 19.	Total 19.	Total 19.	Total 20.

	Formicariinæ.	Dendrocolaptinæ.	Synallaxinæ.
Thoracic	1	2	1
Lumbar	3	2	3
Lumbo-sacral ...	2	2	2
Sacral	2	2	2
Caudal	4+8	4+7	4+8
	12	12	12
	Total 20.	Total 19.	Total 20.

The analyses here given are undoubtedly worth publishing, if only as a basis for further work; but before they can be of any great value a comparison of a much larger series of skeletons than I have been able to make is necessary. The ventri-lateral processes of the second lumbar are in all cases well developed, but those of the sacrals are more feeble, so that some difficulty is experienced in distinguishing, superficially, between sacral and postsacral vertebræ. The dorsi-lateral processes of the sacral and postsacrals are long, keeping the innominates wide apart, while by the ossification of the tendinous tissue overlying them a bony roof to the pelvis is formed, which is most complete in *Pitta* (see p. 151).

In *Pitta* the fourth postsacral forms a part of the synsacrum, although it really lies well behind the embrace of the innominate; on the other hand, in *Xiphocolaptes*, for example, the fifth free caudal lies within this embrace, yet remains free.

Well-marked intercentra, as might be expected, occur in the Dendrocolaptinæ—5 to 7 vertebræ; they are smaller in the Synallaxinæ and Formicariinæ, and vestigial or wanting in the Pipridæ and Philepittidæ.

The ventral aspect of the synsacrum is marked in a way which deserves some notice, inasmuch as it may be either deeply grooved or pitted, after a fashion apparently not met with outside the groups in which these peculiarities occur.

Thus in the Pipridæ the ventral aspect of the synsacrum is marked by deep grooves extending on either side of the middle line from the level of the first lumbar to the sacral vertebræ; while in *Pipra* there will be found a double row of deep oblong pits, one along either side of the middle line, from the last thoracic vertebra (the synsacral) to the first sacral. Among the Synallaxinæ, *Siptornis* agrees with *Chiroxiphia*, while *Synallaxis* agrees with *Pipra*. The Hylactinæ have a grooved synsacrum.

These pittings appear, indeed, to occur only in the Pipridæ, Synallaxinæ, and Acanthidosittidæ, and may extend, as in *Pipra*, along the whole length of this complex as far as the first sacral, or may occur only from the last lumbar to the first sacral, as in *Cinclodes*.

iv. The Ribs.

In the Pipridæ, Pittidæ, Philepittidæ, Conopophagidæ, and Formicariinæ, long styliform ribs are borne by the cervical vertebræ, from the 5th to the 9th inclusive; from the 10th–12th the style is vestigial and a narrow pleurapophysial lamella alone is left. The Dendrocolaptinæ differ in having the styliform portion of the rib much shorter than in the types just referred to. Among the Synallaxinæ it would seem that two types of ribs obtain, one represented by a band-like pleurapophysial lamella, and one in which this is very broad, and may further have a short style as in *Xiphorhynchus*.

There are three cervico-thoracic ribs, the 1st greatly reduced; the 3rd bears an uncinate process but no sternal segment.

There are six thoracic ribs, of which five generally articulate with the sternum. In some of the Synallaxinæ and Dendrocolaptinæ there is a tendency for the 5th rib to lose its connection with the sternal border. The 6th rib, almost invariably articulates with the sternal segment of the 5th, being attached by ligament to a more or less well-defined facet.

The uncinates are generally moderately long and slender, only in *Pitta* are they conspicuously broad.

V. STERNUM AND SHOULDER-GIRDLE.

The sternum of the Tracheophone Passeres throws an interesting light on the evolution of the typical Passerine sternum, in which the *corpus sterni* is quadrangular in shape, with a pair of notches in its posterior border, long anterior lateral processes, and a forked spina externa, the spina interna being wanting.

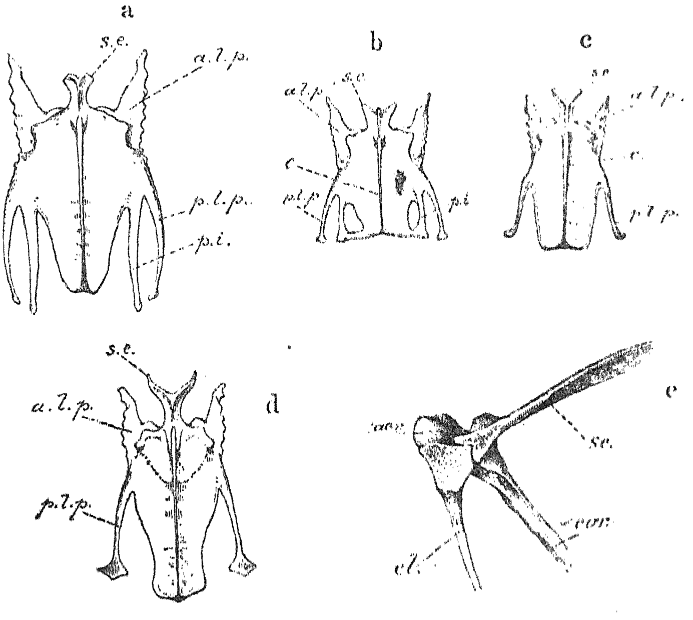
In the Conopophagidæ the sternal plate, however, differs conspicuously from that of all other Passeres, in that there are four posterior notches. Varying in the depth of the notches and other small points in the different genera, these peculiar sterna, together with the sternum of *Pitta*, have hitherto been regarded as modifications independently acquired—those who held this view not regarding the genera which I have grouped together as closely allied forms. Thus, Forbes, for example, in his paper on the genus *Conopophaga* (2), wrote, "As regards the possession of a four-notched sternum by these birds and the Pteroptochinæ, I am not inclined to consider it in any way a primitive character, but rather as an instance of a simple modification having been independently acquired in different groups of birds." Nevertheless, I venture to think that the brigading of these types with four notches to the sternum is justified, not on this character alone, of course, but because of the numerous characters which all share in common.

It is to be noted that among the Coraciiform birds, from which the Passeres are probably derived, a four-notched sternum is the rule. Hence the sternum of the Conopophagidæ may be a survival of this older order of things; on the other hand, it may be that this family has developed this character anew.

I incline to the opinion that the number of these notches is to be regarded as a primitive character, and that while in *Hylactes*, for example, the notches have tended to deepen (text-fig. 51 a, p. 148), so as to acquire a superficial likeness to those of the Bucconidæ, in *Conopophaga* they are on their way to reduction to the normal Passerine number, by the closing of the inner pair, which are now represented apparently by fenestræ only (text-fig. 51 b). Such a method of reduction is common in the Accipitres, for example. In the Menuridæ the posterior border of the sternum is entire; in the Pittidæ but a single pair are left, which, however, are quite unlike the notches in typical Passerine sterna and recall those of the Turnicidæ (text-fig. 51 d)! This form of sternal plate seems to be, however, nothing more than an exaggeration of that met with in *Cinclodes*, for example, as may be seen by comparing text-fig. 51 c. It would seem, indeed, that the Eurylæmid and Formicariid Passeres represent a state of flux in this matter, as well as in the form of the spina externa, which varies in different genera of the same family, as in the Eurylæmidæ and Cotingidæ. In the higher Passeres the bifurcate spina externa and single pair of notches to the posterior border of the sternum are universal.

While in *Conopophaga* the median pair of sternal notches appear to be closing, in *Hylactes* they seem to have reached nearly the maximum development. To find a similar sternum we have to search among the Coraciiformes, that of the Bucconidæ furnishing the nearest approach. But, whereas in the Bucconidæ the posterior-lateral and intermediate processes appear as though given off from a common base—the margin of the deep scar for the origin of the sterno-coracoides,—in *Hylactes* the intermediate process appears as though it had been cut out by stencilling from the sternal plate itself, of which the posterior lateral process forms the outer border. The two notches are subequal in length, and do not extend beyond the middle of the sternal plate. Again, in the Bucconid sternum the sternal plate tapers rapidly to a point, meeting at the hinder end of the carina, while in *Hylactes*, though much incised, the hinder end of the sternal plate, though narrow, is at least nearly as wide as the base of the coracoid.

Text-fig. 51.



Form of the posterior border of the sternum and the relations of the articulations of the bones of the Shoulder-Girdle at the foramen triosseum.

a. *Hylactes*. b. *Conopophaga*. c. *Cinclodes*. d. *Pitta*. e. *Hylactes*.

acr.=acrocoracoid. *a.l.p.*=anterior lateral process. *c.*=carina. *cl.*=clavicle. *cor.*=coracoid. *p.l.p.*=posterior lateral process. *p.i.*=processus intermedius. *s.e.*=spina externa. *sc.*=scapula.

The anterior lateral process in *Hylactes* is of enormous length, projecting far beyond the level of the end of the spina externa: along its free outer border are placed the articular surfaces for the ribs. The *spina externa* is moderately long and slightly pointed. The *carina sterna* is small.

The sterna of all the remaining genera here discussed are of the typical Passerine type, and present but few structural variations: these, however, I will briefly indicate.

Except in the case of the Philepittidæ, all these sterna agree in having a forked *spina externa*—in *Philepitta* it is unforked and small,—a moderately long anterior-lateral process to which alone the sternal ribs articulate, and but a single notch along the posterior free border, the *processus intermedius* being wanting. In the climbing forms of the Formicariidæ and Dendrocolaptidæ the sternal plate is long and narrow, and the keel shallow. In the Philepittidæ and Pipridæ the *spina externa* is pierced on its dorsal aspect by a large pneumatic foramen, and there is a second aperture in the sternum, immediately behind the first. In some of the Synallaxinæ the sternal foramen is found, but the more anterior aperture is wanting.

The coracoid grooves do not meet in the middle line, and have prominent, sinuously curved, dorsal lips: the ventral lips are thin and continued inwards on to the *spina externa*. These grooves attain their maximum development in the Conopophagidæ.

The coracoid shaft is long and slender, but is apparently never longer than the *corpus sterni*. The procoracoid process is never large, and takes the form of a short, oblong, downwardly directed plate; thus, though smaller than in the Eurylæmidæ, it is larger than in the higher Passeres. In the Hylactinæ it extends upwards to fuse with the inturned head of the acrocoracoid. The width of the shaft at its base is increased by a short and narrow flange of bone along the outer border, but this never extends further forward than the level of a line passing in front of the free end of the spina externa.

The *scapula*, except in its relation to the foramen triosseum, which will be discussed presently, presents no features of sufficient interest to demand special notice.

The *furcula* is of the typical U-shape, but varies as regards the development of the hypocleideum and the form of its free ends. The hypocleideum in *Hylactes* and in the Pipridæ is vestigial. In the Pittidæ it is linguiform and rises abruptly from its base: in the Philepittidæ it is almost quadrangular. It is largest among the Dendrocolaptine, Synallaxine, and Formicariine types, where it inclines to a cordiform shape.

The nature of the articulations between the coracoid, scapula, and furcula, where they meet to form the *foramen triosseum*, are interesting. They are of two kinds, one of which is peculiar to the Hylactinæ (text-fig. 51 e), while the other obtains more or less exactly among all the other groups.

In *Hylactes*—Conopophagidæ,—as I have already mentioned, the procoracoid turns downwards to fuse with the inturned portion of the acrocoracoid, thus entirely surrounding the foramen in question. To the outer side of this procoracoid band the expanded free end of the furcula is attached, the dorsal border of this expansion fitting into a triangular notch in the free edge of the acromion process of the scapula: this acromion process, by the way, being set on in advance of the procoracoid band, serves to further increase the length of the roof of the foramen triosseum before referred to.

In the Pittidæ the procoracoid process is wanting: the roofing of the triosseal foramen is consequently furnished entirely by the acromial process of the scapula, while its inner wall is formed by the expanded foot of the furcula. This rests against the acrocoracoid and altogether in front of the acromial process, which, however, it touches by its posterior dorsal angle, and then completes the triosseal foramen.

In the Philepittidæ the procoracoid is moderately well developed and turns abruptly downwards, so as nearly to meet the acrocoracoid, the gap being filled by a ligament. The acromion of the scapula crosses the coracoid, so that it lies immediately over the anterior border of the procoracoid. The upper end of the expanded foot of the furcula is attached, partly to the acrocoracoid, and partly to procoracoid and acromion of the scapula, forming an extensive attachment with its anterior face.

In the Pipridæ the procoracoid lies immediately behind the acromial of the scapula and the expanded foot of the furcula; attached in front to the acrocoracoid, and behind to the scapula, it closes in the triosseal foramen, the actual roof of which is formed entirely by the scapula, the procoracoid forming a sort of penthouse continuation of the roof caudad of the scapula. This arrangement agrees with what obtains in the Eurylæmidæ, the remaining groups here dealt with, and the higher Passeres.

vi. The Pelvic Girdle.

The pelvic girdle differs considerably among the families here under consideration, the more primitive types showing a rather close resemblance to the Eurylæmidæ in this matter.

In *Philepitta* this resemblance is fairly close, especially in so far as the post-acetabular region of the innominate is concerned. In front this element takes the form of a concave, conical blade, which does not rise to the level of the neural spines of the synsacrum, and is set off therefrom by the transverse processes of the enclosed vertebræ; behind the acetabulum the innominate expands to form a broad dorsal plane, which terminates caudad in a point opposite the transverse process of the third caudal vertebra. There is no pectineal process. The ischium is continued backwards and downwards in the form of a narrow curved blade, terminating in a truncated point bent sharply upon the main body of the blade, thus serving to create a wide ischio-pubic fissure, closed posteriorly by the anchylosis of the ischium with the pubis; this last is produced caudad into a moderately long, inwardly curved rod.

In *Pitta* the pre-acetabular ilium is broader than in *Philepitta*, and rounded in front as in the Eurylæmidæ: while the post-acetabular ilium after expanding to form a broad dorsal plane, terminates in a long tongue-shaped plate enclosing a deep notch between itself and the transverse processes of the free caudals: from the lower surface of this tongue there descends a broad plate to fuse with the ischium and enclose the ischiadic foramen.

Anteriorly, it should be remarked, the innominate encloses a deep trough bounded in the middle line by the synsacral crest, and floored by the transverse processes of the vertebræ. The ischium resembles that of *Philepitta*. An unusually broad plate of bone divides the obturator foramen from the ischio-pubic fissure, which is thereby greatly reduced, and is further closed posteriorly by the fusion of the ischium with the pubis, which terminates abruptly just caudad of the ischium.

In the Pipridæ the pelvic girdle also bears a strong resemblance to that of the Eurylæmidæ. The *fovea iliaca anterior* is well defined, and there is also a deep trough between the synsacral crest and the pre-acetabular ilium. As in *Pitta*, the post-acetabular ilium is continued backwards for some distance, but so as to form, not a tongue-shaped plate so much as a spine, between which and the transverse processes of the caudal vertebræ there is a deep notch. The obturator foramen is separated from the ischio-pubic fissure by a narrow bar of bone, but the fissure is not closed posteriorly by the fusion of the ischium with the pubis.

In the Conopophagidæ we meet with a pelvis of a somewhat more specialised type. The pre-acetabular ilia meet one another in the middle line above the synsacral crest, and the *fovea iliaca anterior* is unusually sharply defined, its superior border sweeping round in the form of a sharp ridge to form the anterior border of the dorsal plane, terminating above, but mesiad of, the anti-trochanter. By this meeting of the innominates, the troughs, to which reference has been made, are here converted into *canales ilio-lumbales*. The post-acetabular ilium forms a moderately wide dorsal plane which is continued backwards and terminates in what may be described as a recurved spine, from the lower surface of which descends a broad bony sheet to fuse with the ischium and enclose the ischiadic foramen. The ischium may be described as a band-shaped plate of bone, having its hinder end twisted outwardly to a quite unusual extent and carrying the pubis with it. The obturator foramen is shut in by a bony bar, and the ischio-pubic fissure, which is very wide, is closed by the descending process of the ischium, which is met by a corresponding pedicle from the pubis. The pubis itself terminates in a spine just caudad of the ischium.

The Formicariinæ, Dendrocolaptinæ, and Synallaxinæ are not sufficiently well represented in the collections at my disposal to enable me to say much concerning the form of the pelvis in these somewhat heterogeneous groups, but those genera which I have so far examined in this connection show considerable specialisation in adaption to climbing habits. In the smaller Synallaxine species the pelvis resembles that of the Philepittidæ, having the ischia widely expanded posteriorly and produced into a long rod like foot bent sharply on its long axis, but the pre-acetabular ilium is relatively shorter. In *Siptornis* the pre-acetabular ilia are widely separated, being divided by a deep trough on either side of the synsacral crest; but in *Synallaxis* and *Homorus*, by the shortening of the transverse process of the supporting vertebræ, the innominate bones almost touch one another above the synsacral crest. In *Pseudocolaptes* the pre-acetabular ilia are subconical in shape and rise to the level of the synsacral crest, but are separated therefrom by a narrow space. The form of the ischium agrees very closely with that which obtains among the more specialised Dendrocolaptines: since it turns downwards instead of running backwards beyond the level of the post-acetabular ilium; by this means the depth of the hinder region of the pelvis is greatly increased. In *Xiphorhynchus* and *Dendrocolaptes* this deepening is especially noticeable; furthermore, this is associated with a tendency to close up the obturator fissure by the ossification of the tendinous fascia stretched between the inferior border of the ischium and the pubis. In *Xiphorhynchus* this newly ossified matter hangs down from the ischium in the form of a delicate curtain of bone and is continued forwards and downwards to form a broad bony plate enclosing the obturator foramen.

The pelvis of *Batara*, one of the Formicariidæ, presents some extremely interesting features. In many respects resembling the pelvis of *Dendrocolaptes*, it differs therefrom in having the dorsal border of the pre-acetabular ilium strongly arched, and this curve is followed by the synsacral crest which lies between. The ischium, in its general shape and characters, also closely resembles that of *Dendrocolaptes*, but it differs therefrom mainly in that it fuses completely with the pubis, which is unusually broad and also very short.

In all these pelves the *fovea lumbalis* is extremely small, and the *fovea ischiadica* and *pudendalis* are confluent.

vii. THE PECTORAL LIMB.

The pectoral limb in the groups here described presents a somewhat remarkable uniformity even in structural details: so much so that it would be difficult, on the evidence of the wing alone, to determine to which of these families the skeleton belonged.

With but few exceptions the forearm is the longest segment of the wing, but then is never markedly longer; the arm and manus are subequal. There is no coraco-humeral groove, and the characteristic pit for the *brachialis anticus* is situated below and proximad of the ulnar condyle.

In *Philepitta* the *tuberculum medius*, which forms a kind of penthouse roof over the pneumatic foramen, is perforated by a small hole; and the deltoid crest is short and but feebly developed. The arm and forearm are pneumatic.

The intermetacarpal plate is moderately well developed, and fuses along its hinder border with the metacarpal III., which is slender and bowed.

In the Pittidæ only the humerus is pneumatic. The deltoid crest is obsolete, but the *crista inferior* is well developed and roughly triangular in shape. As in *Philepitta*, there is no coraco-humeral groove, but the ectepicondylar process is better developed than in *Philepitta*.

In the Pipridæ the humerus only is pneumatic, the deltoid crest is short and feeble, and the coraco-humeral groove is wanting. At the base of metacarpal I. is a deep notch continued outwards along the preaxial border of metacarpal II. in the form of a channel for the tendon.

None of the bones in the wing of the Pteroptochinæ is pneumatic; the deltoid crest of the humerus is obsolete and confined to the extreme proximal end of the shaft, and the ectepicondylar process is wanting; the intermetacarpal plate is well developed, and the preaxial border of metacarpal II. is marked by a small, laterally compressed, mound-shaped boss of bone.

As in *Pteroptochus*, so in *Hylactes* the wing is non-pneumatic, and the deltoid crest of the humerus is feebly developed, while the radial and ulnar condyles are set close together.

Metacarpals II. and III. are unusually broad and set close together, reducing the space between to a mere slit.

Of the subfamilies Formicariinæ, Dendrocolaptinæ, and Synallaxinæ, I can say nothing that would be of use. The wing here presents a great general similarity, and it is impossible to say, at present—owing to the lack of skeletons,—whether the slight differences which can be made out are due to individual variation, or whether they obtain throughout whole genera.

viii. The Pelvic Limb.

The pelvic limb in some respects resembles that of the Eurylæmidæ. Although the different groups herein described do not, in this matter, differ very widely one from another, yet this limb presents a greater range of variation than is found in the case of the wing.

In the Pipridæ only is the femur pneumatic, in this matter agreeing with the Cotingidæ; the fibular crest is short, and the fibula continued far down the leg in the form of a delicate style; the cnemial crests are moderately well developed. The Ph. I. of D. IV. is less than half the length of Ph. I. D. III.

The most striking feature perhaps about the Philepittidæ is the oblong, more or less quadrangular shape of the entocnemial process, which rises directly from the level of the articular surface of the shafts and extends forwards and upwards for some distance. The fibular crest is long and low and the fibula produced into a long, needle-like style. The basal phalanges agree in length with those of the Pipridæ.

In the Pittidæ the ento- and ectocnemial crests are linguiform and moderately well developed. The hypotarsus is small, and the outer border of the plantar surface of the tarso-metatarsus bears a long sharp ridge or keel.

In *Pteroptochus*—Conopophagidæ—the great trochanter of the femur takes the form of a knife-like crest, bounded on either side by a deep pit; while the inner tibial condyle terminates in a sharp hook-like process. The ento- and ectocnemial crests of the tibio-tarsus are almost claw-like and of considerable size, and the fibular crest is moderately high and stout. The tarso-metatarsus has a deep and prominent keel running along the outer border of its plantar surface; and has Ph. I. D. IV. less than half the length of Ph. I. D. III. II.

Hylactes has the inner condyle of the femur produced into a blunt spur. The ento- and ectocnemial crests of the tibio-tarsus are well developed, the outer being rather unusually large. Deep ridges on either side of the tarso-metatarsus give the plantar surface a trough-shape: there are but two tunnels in the hypotarsus, and Ph. I. of D. II. III. IV. are subequal.

The femur is pneumatic only in *Dendrocolaptes*, and in this genus the ento- and ectocnemial and fibular crests are not strongly developed; and in *Xiphorhynchus* they are almost obsolete. In this last genus there is a small but sharply defined tubercle above the outer condyle of the tibio-tarsus, and a bony loop immediately below the inner cotylus of the tarso-metatarsus. In *Pseudocolaptes* the ectocnemial crest is well developed, the entocnemial moderately so; the proximal end of the shaft of the tibio-tarsus is bent upon itself and the fibular ridge though short is well developed. The tarso-metatarsus is trough-like behind, and has a bony tendon bridge immediately under the inner cotylus. In *Homorus* and to a less extent in *Pseudocolaptes* the ento- and ectocnemial crests are well developed, but do not extend far down the shaft; the extensor bridge is very wide, and bounded on its inner side by a short bridge running up the tibial shaft and terminating in a tubercle; while a similar but shorter ridge runs up the outer side of the shaft. The fibula is unusually perfect, extending down as a long, almost filamentary, splint to within a short distance of the fused tarsals. Below the inner cotylus of the tarso-metatarsus is a tendinous bridge as in *Pseudocolaptes*.

The size and disposition of the distal trochleæ of the tarso-metatarsus in these groups demand a short description. As in the Eurylæmidæ generally, they lie all in the same plane, and give the shaft immediately above them a conspicuously flattened appearance. But while in the Eurylæmidæ the fused metatarsals are indicated by three very well-marked grooves immediately above the trochleæ, all trace of these separate elements is obliterated in the forms now under discussion. These trochleæ are not only all in the same plane, but they are also all of the same length; in their relative sizes, however, they show not inconsiderable differences.

The Conopophaginæ show the least specialised condition of these parts, in that all trochleæ are large and placed wide apart. The II. is turned inwards. In the Pteroptochinæ all are small: and they are still further, relatively, reduced in the Pipridæ, especially in so far as IV. is concerned. In the Pipridæ III. is the largest, IV. the smallest.

Among the Formicariine and Dendrocolaptine types there appears to be a marked tendency to reduce the IV., and this is well seen in *Homorus*, where trochleæ II. and III. are large, and IV. extremely small. The same is true of *Pseudocolaptes* and *Batara*, though not to so marked an extent. In *Dendrocolaptes* the trochleæ are wide apart, and III. is deeply cleft in the middle. *Xiphorhynchus* is peculiar in having a rather small II. trochlea which is turned inwards, while III. is deeply cleft as in *Dendrocolaptes*.

The depression for Mc. I. is generally well marked, especially so in *Homorus*.

The Formicariine, Dendrocolaptine, and Synallaxine types agree with the Conopophagidæ in that Ph. I. of D. IV. is only about half the length of the same phalanx in D. II. III. In *Pseudocolaptes* all the phalanges of this row are remarkably short, the length decreasing from within outwards; and in *Xiphorhynchus* this abbreviation has been carried to excess, all the phalanges of this row being subequal and extremely short, while in both genera they lie closely pressed together. In *Dendrocolaptes* these phalanges are also short and subequal.

ix. SUMMARY.

Müller (**6**) was the first to utilise the structural characters of the syrinx for systematic purposes. He it was who coined the term "Tracheophone Passeres" and brigaded together the forms possessing this type of windpipe. But his arrangement of the Passeres as a whole was unsatisfactory, inasmuch as he failed to discriminate between what we now regard as Passeres and the outlying forms which go to make up the "Coraciiformes."

Huxley appears to have been the first to differentiate between the Passeriform and Coraciiform types: while the further subdivision of the Passeres seems to have been first placed on a satisfactory footing by Sclater and Salvin (**10**). These authors adopted Müller's "Tracheophoneæ," but for the sub-division of the group which they found necessary they employed such characters as were afforded by the scutellation of the tarsus, the shape of the tail, and so on. Garrod (**5**) improved on this, and it will probably materially aid those who may read this paper if Garrod's scheme is given here. It is as follows:—

Sub-order TRACHEOPHONEÆ.
Fam. 1. Furnariidæ.
Sub-fam. 1. Furnariinæ.
,, 2. Sclerurinæ.
,, 3. Synallaxinæ.
,, 4. Phylidorhinæ.
Fam. 2. Pteroptochidæ.
,, 3. Dendrocolaptidæ.
,, 4. Conopophagidæ.
,, 5. Formicariidæ.

My amendments to this scheme amount to this: I propose to alter the balance and composition of his families 2–5, arranging them as follows:—

Sub-order TRACHEOPHONEÆ.
Fam. 1. Formicariidæ.
,, 2. Dendrocolaptidæ.
,, 3. Furnariidæ.
Sub-fam. 1. Furnariinæ.
,, 2. Sclerurinæ.
,, 3. Synallaxinæ.
,, 4. Margarornithinæ.
,, 5. Phylidorhinæ.
Fam. 4. Conopophagidæ.
Sub-fam. 5. Conopophaginæ.
,, 6. Pteroptochinæ.
,, 7. Hylactinæ.
Fam. 5. Xenicidæ.

In this Sub-order all but the Xenicidæ have a tracheal syrinx; and this is remarkable for the presence of a lateral cartilaginous pillar set on to the bronchial ring by a broad base. In some genera this pillar is extremely well developed; in others it is but small, and may be wanting as in *Conopophaga*, though this genus has hitherto been described as possessing this "*processus vocalis*." As to the development of this process in the Dendrocolaptidæ corresponding to the Dendrocolaptinæ of Sharpe's 'Hand-list,' which includes about eleven genera—nothing seems to be known. In the references to the syrinx of the "Dendrocolaptidæ" which have from time to time been made, this covering title has included both Furnariine and Synallaxine types. These references indeed, in nearly all cases, appear to be based on Müller's dissections (6), who does not seem to have examined any strictly Dendrocolaptine types in this connection.

All the Tracheophoneæ are holorhinal except the Furnariinæ, which are schizorhinal.

Conopophaga, as Forbes insisted long ago (2), has nothing to do with the Furnariine, but seems to approximate towards the Formicariine types. While Sharpe regards it as entitled to rank as a Family by itself, it seems to me that we shall be nearer the truth if we reduce it to the status of a sub-family, and create, to accompany it, the sub-families Pteroptochinæ and Hylactinæ—the former of these being regarded by Sharpe ('Hand-list') as a Family, and the latter as a genus only thereof.

The essential feature of the Conopophagidæ is the 4-notched sternal plate, and the most primitive member of the family is *Conopophaga*. In the peculiar character of the sternum (p. 147) this family is unique among the Passeres.

The Furnariine forms need careful revision. The composition of this family roughly corresponds to the Dendrocolaptidæ of Dr. Sharpe minus the Dendrocolaptinæ, which, it seems to me, should be regarded as a separate Family.

As touching the Xenicidæ, I have recently elsewhere (**8**) contended that this Family is more or less nearly related to the Synallaxidæ, and this largely, but not entirely, on account of osteological characters. More primitive in some respects than this Family, they differ chiefly in the form of the syrinx, which is tracheo-bronchial, and therefore the Xenicidæ would appear to be at the bottom of the tracheophone stem, the members of which split up into holorhinal and schizorhinal types.

The scutellation of the podotheca, largely used in Sclater and Salvin's classification of the Group (**10**), cannot be relied on as a guide to the closer bonds of affinity. Thus, in the Conopophagidæ, *Conopophaga* is exaspidean, like the Tyrannidæ and Pipridæ; *Pteroptochus* is taxaspidean, like the Formicariidæ and Philepittidæ, while the Dendrocolaptinæ and Synallaxinæ are endaspidean.

In the matter of pterylosis all the Tracheophoneæ have a long 10th remex and a vestige of the 11th, and all have a more or less saddle-shaped expansion to the pt. spinalis, the tract behind this being feebly developed.

The curious form of the nostrils of *Xenicus* and the remarkable structure of the external ear I have already described at length (**8**). But little attention has ever been paid to this aperture, and it is probable that a careful study of the form of the external ear will be rewarded by interesting results.

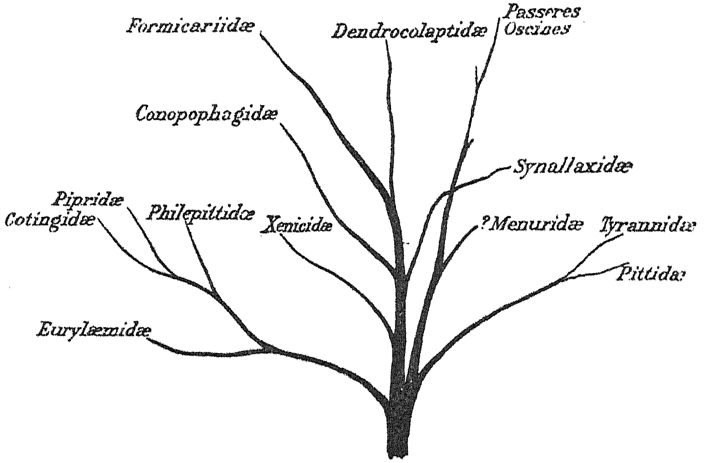
The external nares in *Scytalopus* and *Conopophaga* are covered by a leaf-shaped operculum.

The *deltoideus longus* and *brevis*—muscles of the shoulder-girdle—are, as Dr. Mitchell has shown, of considerable value as factors in classification. In the paper on *Acanthidositta*, to which I have several times referred here, I have shown that these muscles, in this genus, have preserved their primitive character to a very unusual degree: the longus portion being two-headed, the second head being attached to the *os humero-scapulare* and forming with the claviculo-scapular head a large and powerful muscle inserted into the ectepicondylar process of the humerus by a short tendon. In such Tracheophoneæ as I have been enabled so far to examine in this respect, I find the more normal, specialised, condition to obtain. Thus in *Scytalopus* and *Conopophaga* and in *Formicivora* the longus portion has lost the second head, though in *Conopo-*

phaga there is a slender strip of muscle, underlying the clavicular head, which arises from the dorsal aspect of the acromion of the scapula; but this is of no importance. In these three genera the brevis portion is still moderately well-developed, arising from the *os humero-scapulare*, and extending nearly as far downwards as the middle of the shaft; while the longus portion is very slender, but remains fleshy up to the point of insertion, whereas in the other genera referred to it terminates in a long tendon.

With regard to the relationship of the "Tracheophoneæ" to the remaining Passeres, it seems to me that we may regard this Sub-order as one of three main branches of a common stem (see text-fig. 52). One of the extremities may be called the Eurylæmid branch; therefrom have arisen the Pipridæ, Cotingidæ, and Philepittidæ. The Tracheophone comes off, as it were, from the axil of the Eurylæmid branch, while the third, forked at its base, gives rise to the Tyrannidæ and Pittidæ on the one hand and the Oscinine Passeres on the other. As to the position of the Menuridæ I am in doubt at present, but probably they are an offshoot of the Oscinine stem, low down.

Text-fig. 52.



Phylogenetic tree indicating the probable relationships of the "Tracheophone" Passeres.

There is yet much work to be done among the non-oscinine Passeres, but I believe that the present scheme is more nearly phylogenetic than any which has preceded it. I am now engaged on the "Tyrannine" branch, and hope soon to present a summary of my labours thereon.

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3. The Rudd Exploration of South Africa.—IV.* List of Mammals obtained by Mr. Grant at Knysna. By OLDFIELD THOMAS, F.R.S., and HAROLD SCHWANN, F.Z.S.

[Received January 23, 1906.]

Owing to its possession of one of the few forest-areas in Cape Colony, Knysna, at the centre of the southern coast, has always occupied an important position in the history of South African zoology. The name occurs again and again in the literature, from the date of Sir Andrew Smith onwards, and it was therefore thought advisable that a series from so interesting a locality should be obtained by Mr. Grant as part of Mr. C. D. Rudd's magnificent exploration of South African zoology.

Mr. Grant therefore went to Knysna in December 1904, and stayed until the middle of January 1905, when he went for a month to Plettenberg Bay, in the near neighbourhood, after which he again worked at Knysna until April 23rd, when he left for the Transvaal. He was thus in the Knysna district throughout the southern summer.

The series now dealt with consists of about 150 specimens belonging to 31 species and subspecies, of which four have required descriptions as new. Of these by far the most interesting is the distinct Forest Golden Mole, named in honour of Mrs. Rudd *Amblysomus corriæ*, of which Mr. Grant obtained a good series. The species was described in an earlier communication, in order that its skull might be figured in company with that of the Zululand form discovered previously by Mr. Grant.

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* For Part III. see P. Z. S. 1905, vol. i. p. 254.

As usual, the whole series is and will be of the utmost value in more fully working out the details of S. African Mammalogy. Indeed, the lists we are giving of the Rudd collections as they come in are only a first commencement of the use that they will be to Science. For as they accumulate different specialists are enabled to take up group after group, and such useful revisions as that of the *Arvicanthis pumilio* group by Mr. R. C. Wroughton, or of the South African *Rhinolophi* by Mr. Knud Andersen, are thereby rendered possible. To such revisions our lists are a mere preliminary, though we hope that in addition to fulfilling the necessary work of describing the new forms they may also serve a useful purpose from a geographical point of view.

Mr. Grant's notes on the collection are as follows:—

The country around Knysna is decidedly mountainous, varying from sea-level to over 4000′ within a few miles. The highest point of the Outeniqua Mountains is 4666′.

Many miles of the country, especially to the N.E. of Knysna, are covered with dense forest, which becomes more patchy to the east and west, and in many parts is confined to the kloofs and rivers. The principal trees are yellow-wood, iron-wood, stinkwood (laurel), witel, and coomassie. In the more open places and along the banks of the main road ferns are very plentiful.

The open parts are grassy downlands, covered here and there with scrub (fine bush) and sugar-bush.

The first half of my visit was spent in the forest-region, and the latter half in the open veldt at Plettenberg Bay, which is about 20 miles east of Knysna.

1. Cercopithecus pygerythrus Cuv.

♂. 1004, 1006, 1007. ♀. 1005. Knysna.

"'Oapie' of the Dutch.

"Common; frequents the forest-country, and visits the lands and gardens near houses, doing considerable damage. Generally in parties of six or more, although I have occasionally observed a pair with their young only."—*C. H. B. G.*

2. Papio porcarius Bodd.

♀. 1024. Knysna.

♂. Skull only. Plettenberg Bay.

"Found in large troops both in the forest and on the krantzes along the coast.

"Is exceedingly wary and can seldom be obtained. At times, however, they are very bold and do considerable damage amongst the mealies and fruit."—*C. H. B. G.*

3. ROUSETTUS COLLARIS.

♂. 1088, 1090, 1091, 1092. ♀. 1082, 1083, 1085, 1086. Knysna.

"This Bat I found in one cave only, on the Knysna Heads, and it was there literally in hundreds. It was a sight to be remembered to see them coming out in practically one solid sheet on a shot being fired inside the cave.

"I was told that this species was also to be found at Plettenberg Bay and in the forest, but I was unable to obtain it at either place."—*C. H. B. G.*

4. RHINOLOPHUS AUGUR K. And.

♂. 1045. ♀. 1040, 1041, 1042, 1046. Plettenberg Bay.

"I found this species only in one of the many caves examined; it was difficult to secure, owing to the great height of the roof. It is, however, abundantly common everywhere."—*C. H. B. G.*

5. PIPISTRELLUS KUHLII FUSCATUS Thos.

♀. 1027. Knysna.

"Knocked down in forest at night."—*C. H. B. G.*

6. MINIOPTERUS DASYTHRIX Temm.

♂. 1074, 1075, 1076. ♀. 1080. Knysna.
♀. 1039. Plettenberg Bay.

These specimens seem to represent a southern coast species different from that found in Natal and northwards to Mashonaland. They are of a very dark colour on the back, the head rather paler and greyer, and the hair seems longer than in the more northern form. Their forearms are about 45–46 mm. in length.

The males are darker than the females, the latter, instead of wholly blackish backs, having brownish backs fringed with blackish externally at the junction of the membranes with the body. Whether this sexual difference is constant we have hardly enough material to be able to state.

Temminck's *Vespertilio dasythrix** was stated to have come from the "interior of Caffraria," which would seem rather to have brought it into the range of *M. natalensis*; but as the latter is distinguished by its brown instead of blackish colour, and the type of *dasythrix* is described as being "noir mat," a description Dr. Jentink has kindly confirmed, we think the locality—at the best, very vague—should be disregarded, and the Knysna specimens referred to Temminck's species.

With regard to the size of the skull and teeth, these specimens are all quite uniform, with a greatest skull length of about 155 mm., front of upper canine to back of m³ 6·2, greatest breadth of palate including molars 6·3, front of lower canine to back of m_3 6·5. With these measurements those of Temminck's type, kindly taken for us by Dr. Jentink, closely agree, so that there is no doubt as to which of the two Knysna species should bear the name of *dasythrix*.

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* Or "*d'asythrix*," as it was misprinted in the original description (Mon. Mamm. ii. p. 268, 1840).

"Taken in cave on sea-coast."—*C. H. B. G.*

7. MINIOPTERUS FRATERCULUS, sp. n.

♂. 1073, 1077. ♀. 1079. Knysna.

Closely similar in every respect to *M. dasythrix*, agreeing with that species absolutely in colour, even to the peculiarity in the respective coloration of the two sexes. Thus the back of the male is smoky blackish, the head and whole of the under surface dark brown (darker than Prout's brown); the female is dark brown above and below, rimmed with black along the hinder part of the back. But the skull and teeth are very markedly smaller and the forearm rather shorter; though the latter is not so much shorter than in *dasythrix* as might have been expected from the difference in the skulls.

Dimensions of the type, the starred measurements taken in the flesh:—

Forearm 43·7 mm. (other specimens, ♂ 43, ♀ 44).

* Head and body 54 mm.; * tail 52; * ear 9; * tragus 4; third finger 79; lower leg and foot (c. u.) 27·5.

Skull—greatest length 14·7; basal length in middle line 11·2; breadth of brain-case 7·5; height of brain-case from basion 6·3; palate length 5·7; front of canine to back of m^3 5·5; greatest breadth of palate, including molars, 5·6; front of lower canine to back of m_3 5·7.

Type. Male. B.M. No. 5.5.7.18. Original number 1073. Taken 3 October, 1905.

"In cave on sea-coast."

Like as all the eight specimens of *Miniopterus* found at Knysna are to each other in most respects, we have come to the conclusion that they cannot be referred to one species, as in size they fall into two groups, without intermediates. We have therefore described the smaller form as new, while the larger, as already noted, may be referred to *M. dasythrix* Temm.

"Fairly common. *Miniopteri* were taken in both the caves where *Rhinolophus augur* and *Rousettus collaris* were secured."—*C. H. B. G.*

8. MYOSOREX VARIUS Smuts.

♂. 973, 982, 987, 990, 1014, 1015, 1019. Knysna.

These agree very well with those collected by Mr. Grant near Cape Town, though there is more variation among them than is usual.

"'Skearet muis' of the Dutch.

"Very common."—*C. H. B. G.*

9. CROCIDURA FLAVESCENS Geoff.

♂. 1099. Knysna.

10. AMBLYSOMUS CORRIÆ Thos.

P.Z.S. 1905, ii. p. 57.

♂. 971, 1021, 1025. ♀. 958, 968, 970, 1094. Knysna.

This distinct Golden Mole is by far the most striking discovery contained in the Knysna collection. Its skull and teeth were figured in the Zululand paper * in conjunction with those of other species then described, and a detailed account of it was given by Thomas in the paper above quoted.

In quoting † the name *Bematiscus* Cope 1892 as applicable to the *trevelyani* and *villosus* group of Golden Moles, we omitted to notice that an earlier name, *Chrysospalax* ‡ Gill 1884, had been founded on the same two species, and would therefore have to be used for the genus.

"'Swart mol' of the Dutch.

"This Mole is particularly plentiful in the forest, being the only one found there, but is absent from the neighbourhood of Plettenberg Bay."—*C. H. B. G.*

11. GENETTA TIGRINA Schreb.

♂. 960, 992, 996, 1002, 1003, 1010. ♀. 969, 977, 999, 1011. Knysna.

These specimens are very uniform in the small size of their skulls, and the reduction of the inner cusp of p^3 to a mere rudiment.

"Very common everywhere, especially in the forest. Is very destructive to poultry, but is easily trapped."—*C. H. B. G.*

12. HERPESTES CAFER Gmel.

♂. 1071. Knysna.

"'Groot Vaal Muishond' of the Dutch.

"Both nocturnal and diurnal. This Mongoose is now exceedingly rare, having been trapped and poisoned owing to its fondness for chickens. At one time they were to be seen in companies of from four to six."—*C. H. B. G.*

13. HERPESTES PULVERULENTUS Wagn.

♂. 976, 1062. ♀. 961, 1001. Knysna.

"'Blaauw or Vaal Muishond' of the Dutch.

"This Mongoose is not common; it frequents the forest and vleis."—*C. H. B. G.*

14. HERPESTES GALERA Erxl.

♂. 993, 1026. ♀. 965, 991, 1008, 1030, 1093, 1100. Knysna.

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* P. Z. S. 1905, i. pl. xvi. fig. 3.

† P. Z. S. 1905, i. p. 259.

‡ Gill, Stand. Nat. Hist. v. Mamm. p. 136 (1884).

"'Swart Muishond' of the Dutch.

"Almost exclusively nocturnal. Very common in the thick forest near damp vleis and dams, but found occasionally in the open veldt. Is said to feed on tadpoles and frogs." *C. H. B. G.*

15. OTOMYS IRRORATUS Brts.

♂. 972, 1017. ♀. 954, 963, 985, 986, 1029. Knysna.

"'Bosch-rot' of the Dutch.

"Not very common. Frequents the undergrowth in and near the dams and vleis both in the forest and on the open veldt. Diurnal."—*C. H. B. G.*

16. ARVICANTHIS PUMILIO Sparrm.

♂. 952, 953, 955, 962, 981, 988, 1000. ♀. 1023. Knysna.

Mr. R. C. Wroughton[*] considers these specimens to be typical *A. pumilio*.

"'Streep muis' of the Dutch.

"Very common." *C. H. B. G.*

17. ACOMYS SUBSPINOSUS Waterh.

♂. 1097. Knysna, 600′.

This species has only hitherto been recorded from the Cape Peninsula, whence Mr. Sclater mentions a specimen in the S. African Museum from Table Mountain, and Mr. Grant obtained one at Tokai, near Simonstown, at an altitude of 600′. The exact locality of the type has not been recorded.

A. subspinosus may be distinguished from other members of the genus by the structure of its molars, which are more brachyodont than in *A. selousi*, and differ in certain of the cusp details. They are also markedly narrower.

"Trapped in thick undergrowth at edge of forest.

"Not easy to secure. It appears to frequent the rough growths that spring up wherever spaces have been cleared in the forest." *C. H. B. G.*

18. MUS RATTUS L.

♂. 1101, 1066. Knysna.

19. MUS NORVEGICUS Erxl.

♀. 1065, 1095. Knysna.

20. MUS VERREAUXI Smith.

♂. 978, 979, 980, 1012, 1016, 1018, 1020. ♀. 956, 966, 995, 1013. Knysna.

"Common. Frequents the forest, where it is fond of fallen trees, and also the vleis and grass-filled sluits of the open veldt."—*C. H. B. G.*

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[*] Ann. & Mag. N. H. (7) xvi. p. 634 (1905).

21. Leggada minutoides Smith.

♀. 1022. Knysna.

"Apparently rare. Only one specimen was caught."—*C.H.B.G.*

22. Bathyergus suillus Schreb.

Mus suillus Schreb. Säug. iv. p. 715, pl. 204 B (1782).
Mus maritimus Gmel., Linn. Syst. Nat. i. p. 140 (1788).

♂. 1096, 1102, 1105. ♀. 1070, 1103, 1106. Knysna.

The researches of Mr. Sherborn * on the dates of Schreber's 'Säugthiere' have shown that the part in which the "Sandmoll" is described appeared in 1782, and therefore some years before the publication of Gmelin's name.

The reference by Gmelin to Schreber gives further evidence to the same effect.

"'Zand mol' of the Dutch.

"Very common on the west bank of the Knysna River, which appears to be the eastern boundary of the species.

"It is known locally as the 'Brenton' Mole, Brenton being the name of the farm on which it is most plentiful."—*C. H. B. G.*

23. Georychus capensis canescens, subsp. n.

♂. 1108. Knysna 30', 22 April, 1905. B.M. No. 5.8.10.14. *Type.*

A paler form of the common Blesmol, with a more strongly contrasted black head.

General colour of body decidedly greyer than in true *capensis*, the tone nearly matching "smoke-grey" on the fore-back, darkening to "drab-grey" on the hind-back; in *capensis* the back is a uniform isabella brown ("obsolete rufescens," Pallas). Nose-patch, eye-patch, and ear-patch each rather smaller than in *capensis*, the face between them nearly to the crown-patch really black, instead of only slaty blackish; crown-patch larger, very strongly contrasted. Area below ear-patch greyish white, continuous with the greyish white of the sides, throat, and belly; in *capensis* all are more or less tinged with buffy (Pallas even in 1779 speaks of the *area parotica ferruginea*).

Other characters as in *capensis*.

Dimensions of the type, an old male, with the last tooth worn:—

Head and body 156 mm.; tail 22; hind foot 26.

Skull—basal length 40; zygomatic breadth 31.

The remarkable colour-contrasts of the Blesmol are at their maximum in the Knysna form, from the lightening of the general colour of back, sides, and cheeks, combined with the darkening of the face-colour to black, so that the differences are far more conspicuous.

With regard to the dentition of *Georychus*, further consideration confirms us in the idea suggested by Thomas †, that the four cheek-teeth are not p^4, m^1, m^2, and m^3, as usually stated, but p^3, p^3, p^4, and m^1, the missing teeth from the set of six possessed by *Heliophobius* being the two posterior, m^2 and m^3, pushed out as it were by the powerful roots of the incisors, which impinge on them from below.

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* P. Z. S. 1891, p. 587.

† P. Z. S. 1890, p. 449.

This question could, however, only be conclusively settled by a microscopic examination of fœtal or new-born specimens, in which traces of milk-teeth might be found, but in the meantime we think the correct determination will be as here stated.

"'Blesmol' of the Dutch.

"Forms regular runs and mounds similar to other Moles, but they can be distinguished by the size of the heaps thrown up."—*C. H. B. G.*

24. GEORYCHUS HOTTENTOTTUS Less.

♂. 1047, 1049, 1058, 1060. ♀. 1048, 1053, 1054, 1057. Plettenberg Bay.

The Mole-rats referred of recent years to *G. hottentottus* prove on closer examination to be referable to two species, a larger and a smaller, of which the former is more northern and eastern, the latter more southern and western in distribution; but whether and how far they overlap we are not at present able to say with any certainty. The difference in size is chiefly in general bulk, so that it is not easy to give any single dimension which will distinguish the two at all stages, although perhaps the alveolar length of the tooth-row (above 6·5 mm. in the larger, below in the smaller) is as convenient as any. Restricting comparison to old skulls only, the larger species may attain 36 mm. and over in basal length, the smaller rarely reaching 33.

With regard to names, it would appear that *hottentottus*, *cæcutiens*, and *ludwigi* are all applicable to the smaller species, but *holosericeus* Wagn. may be applied to the larger. Thomas has seen Wagner's three specimens, and found that the two "adults" are the large species, and the "young" is the small one. But as the measurements given by Wagner appear to have been taken on one of the larger specimens, that would fix the name on the latter. As to locality, Wagner states that one of his specimens came from Graaf Reinet, which might be taken as the typical locality.

The following are the flesh-measurements of an old male Plettenberg Bay example of *G. hottentottus*, the small species:—

Head and body 142 mm.; tail 15; hind foot 24.

The adult specimens from Plettenberg Bay are of a very light general colour, in marked contrast to those from Knysna, which we have separated under a special heading.

"Trapped in run in open country.

"The runs and mounds of this species cannot be distinguished from those of *Amblysomus corriæ*."—*C. H. B. G.*

25. GEORYCHUS HOTTENTOTTUS TALPOIDES, subsp. n.

♂. 1067, 1068. Knysna.

Similar in essential characters to true *hottentottus*, but colour much darker. General colour of upper surface and sides dark slaty grey, the hairs dark slaty with fine brown tips, the whole most nearly matching Ridgway's "slate-colour" or rather darker; but the crown and a large area on the centre of the back are even darker still, the tips of the hairs being here quite black. The latter dark area extends backwards to the root of the tail. Colour of sides passing gradually into the dull slaty of the belly, which is near "slate-grey," the tips of the hairs dull buffy.

Skull apparently rather narrower and more lightly built than in specimens of *hottentottus* of corresponding age, but the age-question is in each case so difficult to settle that larger series will be necessary before a definite statement can be made on the subject. Incisors rather heavy in proportion to the skull.

Dimensions of the type:—

Head and body 126 mm.; tail 18; hind foot 21.

Skull—greatest length 34; basal length 30; condyles to tip of incisors 35·5; zygomatic breadth 22·5; interorbital breadth 8·7; length of upper molar series (alveoli) 6.

Type. Male, fully adult, but not very old. B.M. No. 5.5.7.89. Original number 1068. Collected 2 April, 1905.

This mole-coloured *Georychus* is no doubt the Knysna representative of *G. hottentottus*, darker than its allies elsewhere, as is usually the case with animals from forest-regions.

Mr. Grant's beautiful skins of this and other *Georychi* bring out clearly that the crown and dorsal area are generally darker than the rest of the body, a distinct lighter band, coloured like the sides, passing across the back at the shoulders, and separating from each other the darker crown and dorsal patches.

26. LEPUS SAXATILIS.

♂. 1056, 1061. Plettenberg Bay.
♂. 1104. Knysna.

"Fairly common on the open veldt, wherever the hill-sides are more or less stony. A fair number were observed, but mostly in the thick patches of scrub, where it is impossible to shoot them."—*C. H. B. G.*

27. HYSTRIX AFRICÆ-AUSTRALIS Peters.

A young skull. Plettenberg Bay.

28. PROCAVIA CAPENSIS Pall.

♂. 1031, 1032, 1034, 1052, 1055. ♀. 1035, 1036, 1037, 1038. Plettenberg Bay.

This series exhibits unusual variability in colour.

29. CEPHALOPHUS MONTICOLA Thunb.

♂. 1028. ♀. 1072. Knysna.

"'Blaauw bokje' or 'Numegy' of the Dutch.
"Very common."—*C. H. B. G.*

30. NOTOTRAGUS MELANOTIS Thunb.

Nototragus, nom. nov., Thos. & Schw. Abstr. P. Z. S. No. 27, p. 10, Feb. 27, 1906.

♂. 1051. ♀. 1059. Plettenberg Bay.

We are glad to express our agreement with Dr. Jentink * in considering that the Grysbok should be generically separated from the Steenboks on account of its possession of supplementary hoofs. In the skull also it may be distinguished by its larger anteorbital pits, which are shaped very much as in *Ourebia*, with a marked ridge above them, running across the lacrymals.

But in using Sundevall's name of *Calotragus* for this animal, Dr. Jentink has not noticed that that author expressly selected his "*species prima*" (*Calotragus tragulus* = *Raphicerus campestris*) as the type, so that in no case could the name be used for the Grysbok, to which we would therefore propose to apply the above-given generic term.

With regard to the use of *Raphicerus*, we can only reiterate the opinion given in the 'Book of Antelopes,' that Blainville's figure of "*Antilope acuticornis*," on which the name hangs, is either the common Steenbok (as we suppose) or at least a species congeneric with it.

31. TRAGELAPHUS SYLVATICUS Sparrm.

♀. 1050. Knysna.

4. Notes on the Living Specimens of the Australian Lung-fish, *Ceratodus forsteri*, in the Zoological Society's Collection. By BASHFORD DEAN, Ph.D. †

[Received November 6, 1905.]

(Plate IX.‡ and text-figs. 53–55.)

During a recent visit to London, September 1904, I was given the opportunity of examining specimens of *Ceratodus* in the aquarium of the Zoological Society's collections. And the following notes are presented, since they add several details to our rather scanty knowledge of the habits of this important and rare form.

The following is an abstract of the more important accounts of living *Ceratodus*:—

Habits in general.—Never goes out of water (according to all recent authors), could not be "made to progress in only a few inches of water" (Ramsay, similarly Spencer). Passive, helpless out of water (Spencer, Semon, Illidge), and dies within one or two hours (Semon), or eight to ten hours (Spencer): if kept moist, however, it will live for a long time (O'Connor), *e.g.* if wrapped in wet water-weed. In general hardy and now acclimated in a number of Australian rivers. Under usual conditions sluggish, "too lazy to get out of the way when about to be handled"

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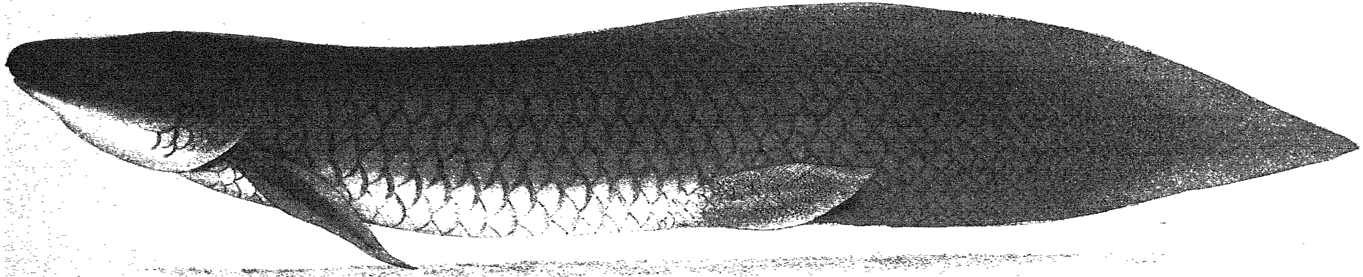
* Notes Leyd. Mus. xxii. p. 33 (1900).

† Communicated by R. I. POCOCK, F.Z.S.

‡ For explanation of the Plate, see p. 178.



J. Green lith.

Bale & Danielsson. Ltd. imp.

CERATODUS FORSTERI.

(Ramsay), can be touched (Semon). Apt to rest for hours on the bottom, pectoral fins extended at right angles to the body, pelvics parallel with it (Ramsay). Neither diurnal, nor nocturnal, seeking food regardless as to the hour of the day (Semon).

Breathing.—Does not open gills when out of water (Ramsay). Rises to the surface to breathe every thirty or forty minutes (Semon), but more frequently at night (Ramsay). Lung especially important when water becomes muddy or foul (many authors). Sounds sometimes emitted, "spouting," a "groaning sound" (Semon), a "pig-like grunt" (Illidge).

Swimming.—Progresses chiefly by "waves of the tail" or "by paddling with pectoral fin alone." When disturbed "lashes out with its great strong tail, and turning sideways squeezes in between some tufts of grass." "Eel-like in movements"—not apt to swim straight forward; in this event, however, pectorals are used, not caudals (Ramsay). "Swims a short distance with a jerk, when it will rest again" (Semon). Its movements are, however, best described by Semon, after notes made (1899) upon the present specimens by Arthur Thomson: he distinguishes three kinds of progression—(1) a slow forward movement in which the pectorals play the most prominent part, waving "like a flag in a moderate breeze"; (2) a rising movement, accomplished almost exclusively by the pectorals, after which the fish sinks slowly to the bottom Triton-like; and (3) a rapid strong swimming, accomplished by the caudal, the pectorals and ventrals being opposed to the side of the bottom, as in the case of rapidly swimming amphibians. Thomson observed especially the fish in a position of rest balancing either on its ventromedian line, or partly lifted up supported on its spread out pectorals, or further lifted or supported by both pectorals and ventrals, the last position having been figured (*cf.* text-fig. 53, 3, p. 173). This supporting function is particularly emphasised by Semon as a step important functionally in the evolution of the land-living vertebrate limb. Thomson, however, was unable to see the alternate movements of the limbs, which had been described in *Protopterus*, or an elbow-like bending of the base of the pectoral fin.

Food.—Many authors emphasize its vegetivorous habits (Günther, Spencer); Semon, on the other hand, maintained that the food is "essentially animal," the plant-material furnishes but a vehicle for the animal food, and remains, therefore, undigested. Margo, finally, has determined by microscopical examination that in cases where the plant portion of the food-material is undigested in the anterior part of the gut, in its hinder part there is convincing evidence of complete digestion, leading to the conclusion that the diet of *Ceratodus* is a mixed one.

Colour.—"Greenish brown on back, and slaty on belly"—after capture "becomes very prettily coloured with red, pink, and violet hues on the abdominal parts," colours which disappear after the death. The surface of the fish is "oily" (Illidge).

The present specimens—two in number,—as has already been recorded (P. Z. S. 1898, p. 492), were secured in the Burnet River, Queensland, during the beginning of 1898. They have accordingly been kept in captivity for upwards of seven years*. Two other specimens, however, which were brought from Australia at the same time and which passed into the possession of the aquarium in Paris, lived, it is understood, but a short time. It is stated that on one occasion during the transportation of these fishes suitable tanks could not be procured and that the specimens were sent for a distance overland wrapped only in wet moss and water-weed—an item which is here referred to since it indicates the air-breathing capability of these fish (*cf.* O'Connor). At the time that the present notes were prepared both fish appeared to be in good condition, although one of them was darker in colour and more active than the other.

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* During this interval they appear to have grown at the rate of a little more than an inch a year.

The behaviour of the fish indicates that it is distinctly a bottom-living form: it is sluggish in habit, its movements are deliberate, and its general behaviour suggests that of an amphibian, e.g. *Necturus*. As an example of the passiveness of the fish it may be mentioned that when the fish was photographed it was thrust about by the attendant until it was brought into the focus of the camera, and it would usually bear this treatment without excitement, behaving very much as would a Triton under similar circumstances. A feature which one is soon apt to note is a peculiar ventro-median ridge, which suggests that of *Chlamydoselachus*. From the behaviour of the fish and from numerous experiments one is given the impression that the eyesight of *Ceratodus* is poor, or, more accurately, that the reaction of the fish to optical stimuli is remarkably slow. In this connection it was noted that the eyes exhibited numerous and marked movements, as though the fish were making an effort to see. From this peculiarity I was led to inquire whether the fish could see better by night than by day; and this I was able to accomplish, thanks to one of the many courtesies of Mr. R. I. Pocock, the Superintendent of the Society's Gardens. From these observations it was evident that the fish is far more active by night than by day. It was found that the fish which remained quiescent in a dark corner of the tank by day circled uneasily by night. In one instance the fish was observed to pass twice around the tank in the period of one minute; and on several occasions the fish broke the surface of the water boldly as though seeking to escape. The movements of the fish on these occasions could be adequately seen: for the observer standing in the dark was so placed that he looked through the tank and saw the fishes silhouetted against the skylight of a neighbouring room. There is accordingly, it appears, but little doubt that *Ceratodus* is to be regarded as largely nocturnal in habit. Especially was this evident when a living Frog was dropped into the aquarium, for it was found that its presence was noted almost at once.

In colour, one fish was much lighter than the other—somewhat greyish on the sides and back, and of a paler shade on the abdomen. It is possible, by analogy with ganoids, that this specimen may prove to be a female. The other specimen, possibly a male, is much darker—blackish bottle-green, its surface slimy, with a velvety bloom like the skin of a Salamander (Plate IX.). The fins are darker in colour than the sides: the head is darker and greener. The light colour on the ventral side of the head and on the lower lip distinctly orange. Of the extreme colours should be noted the darkness of the upper rim of the mouth and the paleness of the axil. The eye shows a distinct greyish line within the orbit: it is somewhat dull in colour and the iris brown. The scales appear most prominently when the fish exhibits an undulating movement, their lighter-coloured proximal rims, usually covered by the neighbouring scales, then becoming exposed.

In its movements the fish suggests an amphibian: it will lift its head from the bottom, raising itself upon the bases of its pectoral fins and will thus pose for several minutes. In this process it exhibits occasionally neck-movements which are distinctly unfish-like. Sometimes it will then push itself back in a way which has been noted in the African Lung-fish, *Protopterus*. In general, however, the movements of the fish in swimming are more ganoid-like than in the latter form. It swims leisurely about the aquarium, undulating the body and balancing with the pectoral fins, thus operating very much like those of the living Ganoids. In more energetic movement it will sometimes show the pectorals fluttering above the head as it rapidly raises and depresses them, the tips of the fins being flexible. There is, however, less tendency for the alternate movements of the pectoral fins; this, in fact, was rarely observed, and there was very little movement noted in the ventral fins: they are, therefore, far more passive than in *Protopterus*. It was observed on some occasions, when the fish was swimming near the surface, that it would suddenly cease its movements and slowly sink (horizontally) to the bottom, its fins extended at the sides, acting as parachutes. When alarmed, on the other hand, it is capable of vigorous movements, sweeping forward by strong strokes of its caudal, the pectorals and the ventrals folded tightly against the body, very much, as Semon remarked, as in the case of a rapidly swimming amphibian.

The best idea of the usual movements of *Ceratodus* may perhaps be had by reference to the accompanying figures, which have been copied from pencil sketches.

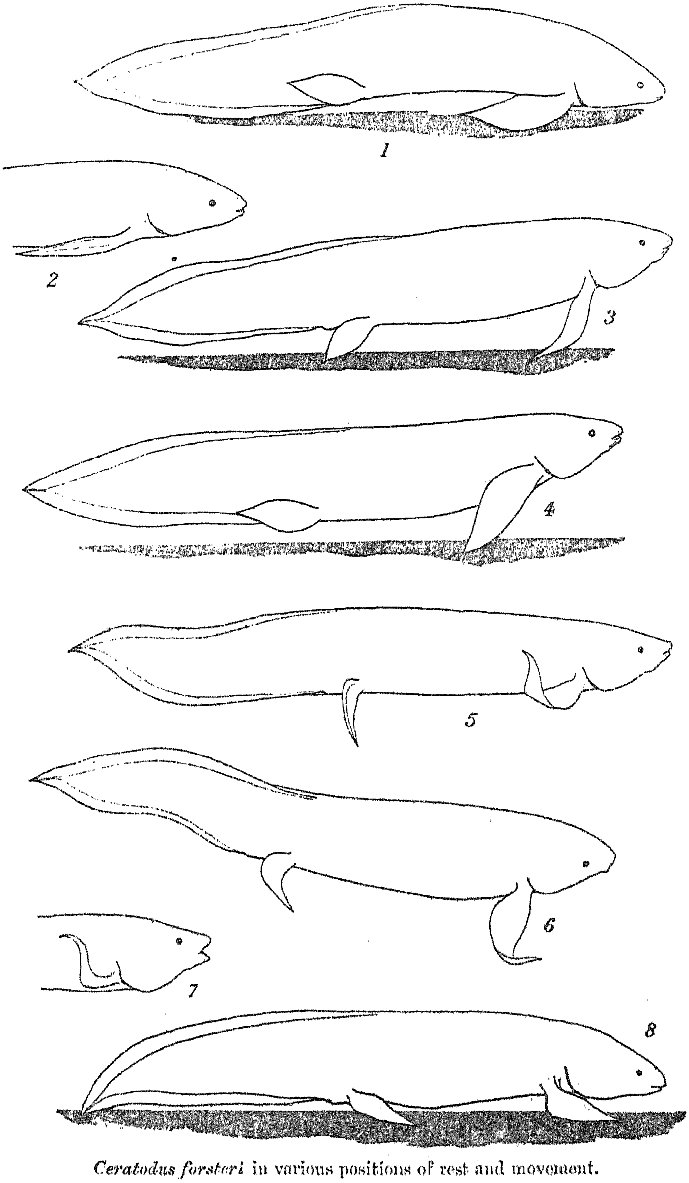
The aquatic respiration of *Ceratodus* is normally slow and regular: the opercular cavity fills and empties about twelve times a minute, and during the process it may be observed that the mouth is scarcely opened. Occasionally, however, it will open its mouth and "gasp" spasmodically. It is clear, however, that the fish is a nostril-breather. The mouth itself shows no movement of opening or closing; it is indeed hardly open, the gape being scarcely more than 3 millimetres. The nostrils, on the other hand, are widely dilated, and on one occasion a twitching was observed, which was by no means fish-like. It was also noticed that the aquatic respiration became more rapid after the fish had become excited, *e. g.* after it had been pushed about the tank in order to be photographed; the number of respirations then became as numerous as thirty in the minute.

Breathing by means of the lung takes place at considerable and somewhat irregular intervals: from forty to sixty minutes would include the usual periods. When excited, however, the fish breathes more rapidly, and on one occasion the interval of aerial respiration was found to be as brief as eight minutes. Before rising to the surface the fish shows evidence of uneasiness; it will sometimes "gasp" several times, move backward, bend its head or twitch its fins: it will then rise to the surface, usually slowly, and "spout," *i. e.* exhale and draw in a mouthful of air somewhat spasmodically. Sometimes it will make several gulps; it will then close its mouth and sink to the bottom. In this process, bubbles always pass out on either side of the head as the fish sinks. In one instance it was observed that the air passed out mainly on the left side, and it was also noticed that the fish will sometimes rock slightly from side to side as it sinks. Sometimes a few moments later a large bubble will issue from the mouth. It was also noted that if the fish becomes excited and shows energetic movement, air will be ejected. It may finally be noted that at night the breathing-movements appear more frequent than during the day: air was taken in at an interval of fourteen minutes (*cf.* Ramsay): this is doubtless correlated with the more active habit at this time. It may be remarked that the air-breathing habit of *Ceratodus* seems to be closely similar to that of *Protopterus*.

In feeding-habits *Ceratodus* resembles an amphibian. It will snap at the food in a similar way, and shows a movement of the head which is more nearly amphibian than fish-like. On one occasion it bent its head to the side very much as would a Salamander. It has already been mentioned that *Ceratodus* is slow of sight; this is especially evident when food is taken. In some cases food will remain for ten minutes in the water before it is noticed by the fish, stimulation appearing to come rather from the taste-buds than from the eyes. It will "feel" apparently that there is something edible in its neighbourhood and it will gradually move in the direction of the stimulus. It was noted that if an object were placed on the surface of the water at the opposite end of the tank the fish would not rise in the direction of the food, but would grope its way uncertainly along the bottom until it came under the food; then it would rise to seize it. The fish impresses one as taking its food blunderingly; it will sometimes snap repeatedly before it succeeds in securing the object. It would often seize a mouthful, then eject it, then hunt it up again, mouth it, and finally swallow it. The feeding of the present specimens indicates convincingly that the diet of *Ceratodus* is, as Margo maintained, a mixed one. Animal food, living and dead, is regularly taken, also vegetables, *e. g.* lettuce; and that the latter is actually digested and assimilated seems clear, since it is not to be recognised in the fæcal material.

In the accompanying figures (text-figs. 53 and 54) the fish is represented in positions both of rest and of movement. In fig. 1 the fish appears in a not uncommon pose; it balances accurately on the pectoral fins and in the anal region, its trunk somewhat arched upward and the head thrust close to the bottom, the pectoral fin extends sideways in such a way that its postaxial border rests against the bottom. In a somewhat similar position (fig. 2) the fish is flattened out more closely to the ground and the pectoral fin lies

Text fig. 53.



Ceratodus forsteri in various positions of rest and movement.

similar movement is shown in fig. 13, the fish viewed from above. In fig. 14 is shown a rather unsuccessful attempt to depict the fish in resting position, viewed from the side and behind, and in the three following figures are shown sketches of the fish made from in front. In fig. 15 the slowly flapping pectorals are shown in a somewhat rare position, paddling alternately: in this position, by the way, one notes the almost closed mouth and the dark openings of the nostrils just within the rim of the upper lip, through which the major supply of water is passing to the gills. In fig. 16 the fish is represented in somewhat the same position as shown in lateral view in fig. 9: the preaxial border of the fin is turned inward, and in this sketch the opercular flaps appear well distended. In fig. 17 a forward movement is again indicated; but in this the undulation of the entire trunk is slowly functioning, and the pectorals are relatively inactive. In fig. 18 a position of rest is represented, which is not widely different from that shown in fig. 3: in this case, however, the pectoral fins do not quite touch the bottom; the head, however, will shortly sink and the fish assume the position shown in fig. 3.

In text-fig. 55 the attempt is made to indicate the movements of the fish in the process of coming to the surface to breathe. In fig. 19 it swims slowly to the surface, the paired fins flapping lazily. In fig. 20 a similar position is shown. In fig. 21 the head is shown thrust vigorously above the surface, the mouth widely open in the process of filling the opercular cavity with air. In fig. 22 the fish paddles backward, closes its mouth, and commences to contract the opercula. In this process, during which evidently the air is pressed into the lung, bubbles escape through the imperfectly closed opercular slits on either side, and sometimes also through the closing mouth.

The behaviour of *Ceratodus*, in conclusion, is decidedly like that of an amphibian. In the first place, it breathes largely through its nostrils; in the second place, it is salamandrine in its movements. Not only does it support itself on its fins, as Arthur Thomson observed, but it is able to push itself backward, in this operation indicating that an elbow-like joint is functional. It has also been observed to paddle forward, using alternate movements of the pectoral fins. It is not, however, so amphibian-like in its movements as *Protopterus*, which will "walk" forward balancing itself on its paired fins. Of exceptional interest in *Ceratodus*, finally, are the movements of the neck and head, which suggest strikingly those of Salamanders.

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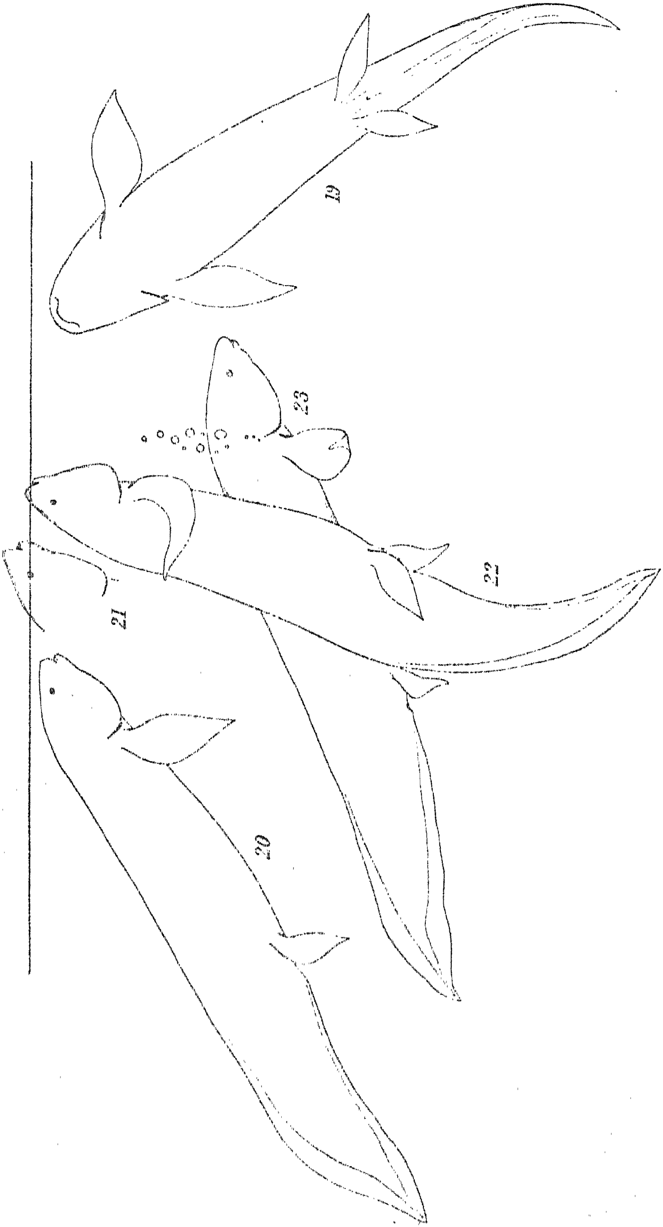
Text-fig. 55.



Ceratodus forsteri in various positions at the time of its coming to the surface to breathe.

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EXPLANATION OF PLATE IX.

The Australian Lung-fish, *Ceratodus forsteri*, from a coloured sketch by Dr. Bashford Dean of a specimen living in the Zoological Society's Gardens.

'Proceedings,' 1905, Vol. II. Part II. was published on April 5th, 1906.

March 6, 1906.

Dr. Henry Woodward, F.R.S., Vice-President,
in the Chair.

Mr. G. A. Boulenger, F.R.S., V.P.Z.S., exhibited a specimen of the largest Frog known, *Rana goliath* Blgr., from South Cameroon, described in the 'Annals and Magazine of Natural History' (1906, xvii. p. 317). This Frog measured 10 inches from snout to vent, and was one of the most interesting discoveries made by Mr. G. L. Bates, C.M.Z.S. Mr. Boulenger stated that an even larger living specimen intended for the Zoological Gardens had been secured by Robertson, the young keeper who had accompanied Mr. Bates to Cameroon last summer in order to collect animals for the Society; but the specimen, which he had kept in a large tin, escaped during the night.

Among other Batrachians which Robertson had been able to keep alive, but did not succeed in bringing home, were examples of the large West-African Tree-Frog, *Hylambates rufus* Reichen., one of which, at the end of August, produced a number of eggs, which were also exhibited before the Meeting. These eggs were remarkable for their large size, 5 or 6 millimetres in diameter, and the absence of pigment. No doubt, to judge by the size of the vitellus, the young of this Frog undergoes at least a considerable part of the metamorphosis within the egg. On recently opening the mouth of a female *Hylambates brevirostris* Werner, from South Cameroon, forming part of Mr. Bates's collection, Mr. Boulenger was surprised to find it contained a few large yellow eggs, 4 millim. in diameter, very similar, except for their size, to those of the larger *H. rufus*. Other eggs, identical with those in the mouth, were still in the oviducts. This mode of nursing approached that of the Chilian *Rhinoderma darwini*, in which the male keeps the eggs in the much-distended vocal sac until the young are hatched in the perfect condition. The buccal nursing by the female made a novel addition to the already long list of extraordinary breeding-habits in Batrachians.

Mr. R. T. Günther exhibited some specimens of the Medusa, *Limnocnida tanganicæ*, obtained by Dr. W. A. Cunnington in Lake Tanganyika during the winter months of 1904–05. The collection was of importance, because it clearly demonstrated that the views of Mr. J. E. S. Moore with regard to the life-cycle of the Medusa were erroneous, for whereas in 1897 Mr. Moore thought that he had discovered* that the asexual method of reproduction by budding ceased in June and July (a conclusion which he stated that he had confirmed in 1900 during the months of September and

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* Proc. Zool. Soc. 1899, pp. 291–2. In this paper, "Boehm, 1887," should read "Boehm, 1883."

October, when sexually mature individuals swarmed, though none showed any tendency to form buds*), Dr. Cunnington's carefully collected material, on the other hand, showed that reproduction by budding was continued in August, September, December, and February, and that it might therefore reasonably be supposed that it went on during the greater part of the year—if, indeed, it ever ceased.

The discovery of *Limnocnida* in other river-basins in Africa had materially weakened the case of those who considered that Lake Tanganyika was the last surviving remnant of a Jurassic Sea. The fact that this Medusa had been found in the Victoria Nyanza by M. Ch. Alluaud and Sir Charles Eliot, and also in the Niger by the late Mr. Budgett, proved that it was another instance of a member of the freshwater fauna characteristic of the Central-African Region, and that it was not peculiar to this one deep-water lake as had been originally supposed.

Mr. G. A. Boulenger, F.R.S., V.P.Z.S., read a paper entitled "Fourth Contribution to the Ichthyology of Lake Tanganyika. Report on the Collection of Fishes made by Dr. W. A. Cunnington during the Third Tanganyika Expedition, 1904–05."

This paper will be published entire in the 'Transactions.'

The following papers were also read:—

1. Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905. Report on the Mollusca. By Edgar A. Smith.

[Received February 6, 1906.]

(Plate X.†)

The small collection of Mollusca obtained by Dr. W. A. Cunnington in Lake Tanganyika does not contain any important addition to the thalassoid series. There are some interesting specimens of *Bythoceras iridescens*, tending to show that, like most freshwater species, it is subject to considerable variation. In two cases, *Edgaria* and *Giraudia*, I have been enabled to describe the opercula, which hitherto were unknown, and the collection also affords one new species of the genus *Anceya*. The various localities furnished by Dr. Cunnington also add to our knowledge of the distribution of some of the forms. Another matter which may be referred to in these introductory remarks is the occurrence together, at the south end of the lake, of both the keeled and unkeeled varieties of *Neothauma tanganyicense*, which, according

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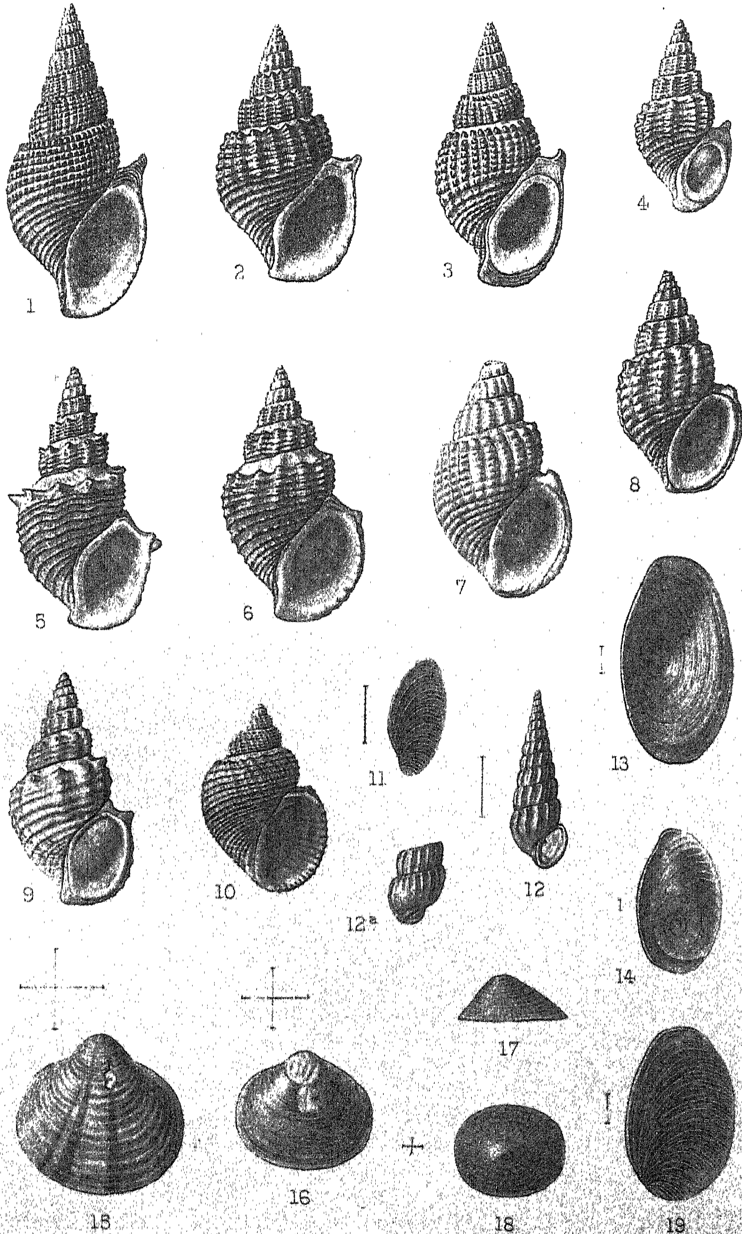
* J. E. S. Moore, 'Tanganyika Problem,' 1903, pp. 298–308.

† For explanation of the Plate, see p. 186.

P.Z.S.1906, vol.I. Pl.X.



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MOLLUSCA FROM LAKES TANGANYIKA & VICTORIA.

to Mr. J. E. S. Moore*, were found by him, respectively, only at the south end and more northern localities.

Living examples were obtained of *Limnotrochus*, *Tiphobia*, *Bythoceras*, *Paramelania*, *Lavigeria*, *Edgaria*, *Giraudia*, and *Anceya*; and these it is proposed to place in the hands of an experienced anatomist for investigation. The last three of these thalassoid genera have not been anatomically examined, and therefore it will be of interest to know their relationship and systematic position, and it will also be interesting to see if the conclusions arrived at, in respect of the rest, coincide with the results of Mr. Moore's investigations of them. In concluding these prefatory observations on the marine-like forms, I would again † call attention to the fact that M. Bourguignat had employed the term "thalassoid" in connection with them long before the invention of the compound "halolimnic" by Mr. Moore.

Among the ordinary freshwater forms, the discovery of a species of *Ancylus*, the first from the lake, is of interest. This genus has been recorded from the Victoria Nyanza, but not from the other large lakes of Central Africa. Being, however, such small objects, and difficult of observation, they may have easily been overlooked ‡.

Of the few species obtained by Dr. Cunnington in the Victoria Nyanza, two appear to be new, namely, a *Corbicula* and a *Sphærium*, both closely allied to one or other of the few forms already known from this lake.

I. *Species from Lake Tanganyika.*

a. THALASSOID SPECIES.

1. CHYTRA KIRKII (Smith).

Hab. Tembwi, a little below middle of west coast, 20 fath.

2. BATHANALIA HOWESI Moore.

Hab. Niamkolo, south end of lake.

The dimensions of this species, which have never been stated, are:—Length 30 millim., diam. 22; aperture 11½ long, 10 broad.

3. LIMNOTROCHUS THOMSONI Smith.

Hab. Ndanvie, east coast towards the north end of the lake, 10 fathoms, also at south end.

4. TIPHOBIA HOREI Smith.

Hab. Kala, at south end of lake.

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* 'The Tanganyika Problem,' p. 149.

† See Proc. Malac. Soc. vol. vi. p. 78.

‡ M. Louis Germain has recently briefly described from Tanganyika new species of *Planorbis*, *Vivipara*, and *Cleopatra*. Bull. Mus. Hist. Nat. Paris, 1905, no. 4, pp. 254–261.

5. **Bythoceras iridescens** Moore. (Plate X. figs. 1–3.)

Hab. Niamkolo, south end of lake.

The series of specimens now available for examination shows that this species, like most freshwater forms, exhibits considerable variation in size, form, and sculpture. The much enlarged figure in the Proc. Royal Soc. 1898, vol. lxii. p. 452, fig. 1, reproduced in the Proc. Malac. Soc. vol. iii. p. 93, fig. 1, exhibits an extreme development of the anterior or basal spine, such as I have not seen in any specimen. The largest example in the present collection is 44 millim. in length, and the spire is much longer in proportion to the length of the body-whorl than in the shell depicted by Mr. Moore, and the sculpture is altogether finer. A smaller variety, but equally adult, is more strongly sculptured than the large form and only 30 millim. in length.

6. **Bythoceras minor** Moore. (Plate X. fig. 4.)

Hab. Tembwi, west coast, a little below middle, in 20 fath.

A single specimen only. I am inclined to think that this species will eventually prove to be a variety of *Paramelania crassigranulata.* In the character of the shells, opercula, and radulæ there seems to be very little to separate the genera *Bythoceras* and *Paramelania.*

7. **Paramelania crassigranulata** Smith. (Plate X. figs. 7, 8.)

Hab. South end of the lake.

One very large specimen, 37 millim. in length.

8. **Paramelania damoni** Smith. (Plate X. figs. 5, 6, 9.)

Hab. Tembwi, near middle of west coast of the lake, 30 fath.; Mrumbi, south of Tembwi, 40 fath.; Mshale, east coast towards the north end of the lake, 25 fath.; also south end.

The single specimen from the last locality resembles the variety *imperialis* rather than the typical form.

9. **Lavigeria grandis** Bourguignat. (Plate X. figs. 10, 11.)

Hab. Mbete, south end of lake, on rocks in shallow water.

A few specimens rather smaller than the type (P. Z. S. 1881, pl. xxxiv. fig. 26 *a*), with the oblique plications less strongly developed.

10. **Edgaria nassa** (Woodward). (Plate X. fig. 19.)

Hab. Kirando, east coast of lake towards the south end.

A few specimens of a small variety. Operculum similar in character to that of *Lavigeria grandis*, horny, dark brown, broadly ovate, nucleus marginal, near the lower end, sculptured with fine lines of growth.

11. **Edgaria paucicostata** Bourguignat.

Hab. South end of the lake.

Two rather large specimens, 21 millim. in length.

12. TANGANYICIA RUFOFILOSA (Smith), var.

Hab. South end of lake.

One very black specimen, having evidently been stained in black mud. It is very different in shape from the type, being more ovate, with a longer spire, and the umbilicus nearly closed.

13. SPEKIA ZONATA (Woodward).

Hab. Niamkolo, south end of lake, on stones in shallow water.

14. GIRAUDIA HOREI Smith. (Plate X. fig. 13.)

Hab. Mrondwe Bay, south end of lake, 10 fath.

A few examples, rather smaller than the type. Operculum ovate, horny, brown, paucispiral in the middle, with concentric lines of growth at the outer margin.

15. GIRAUDIA PRÆCLARA Bourguignat. (Plate X. fig. 14.)

Hab. Moliro, west coast of south end of the lake, on rocks in shallow water.

A few specimens, rather smaller than the type. The minute horny operculum, 1 millim. in length, consists of a single whorl, the nucleus being subcentral, but nearer the lower end. It is subovate, being rather narrower below than above.

16. ANCEYA RUFOCINCTA, sp. n. (Plate X. fig. 12.)

Shell small, elongate, subulate, imperforate, yellowish horn-colour, with a dark red band at the upper part of the whorls. Whorls 13, slowly increasing, slightly convex; apical whorls probably smooth and convex, the two topmost remaining with two spiral threads round the middle crossing the costæ, which are much finer and more numerous than those upon the lower volutions. Costæ strong, oblique, about twelve or thirteen upon the penultimate whorl, those upon the body-whorl terminating abruptly at a strong spiral ridge which encircles the base. In a young specimen this ridge is absent, so that probably it only occurs in adult shells. Aperture oblique, broadly sinuated above and below; peristome continuous, brownish, outer margin thickened, a little expanded, columellar side also thickened and reflexed, with a distinct tooth or fold at the upper part, joined to the outer lip by a distinct callus. Operculum none? Length 8½ millim., diam. 2½; aperture 2 long, 1¼ broad.

Hab. Kirando, towards south end of the east coast, 10 fath.

Apparently differing from the two known species of the genus *Anceya* in colour, form of the aperture, and the character of the costæ. *A. giraudi* Bourguignat has a palatal liration which is absent in the present species. In his figures the outer lips have the appearance of being drawn from broken specimens. If, however, they are normal, they are very different from the labrum of the present species. In a young specimen both the basal keel and the columellar tooth are absent, so that these are probably features which are only developed in adult shells. Having broken up one specimen, I failed to find an operculum.

b. NON-THALASSOID SPECIES.

1. LIMNÆA NATALENSIS Krauss.

Hab. Swamp at Mbete, south end of lake.

2. ANCYLUS TANGANYICENSIS, sp. n. (Plate X. figs. 17, 18.)

Shell very small, roundly ovate, moderately elevated, thin, brown, finely radiately striated across the concentric lines of growth; apex obtuse, boss-like, circumscribed, radiately striated, subcentral or a trifle towards the right; interior glossy, exhibiting through the semitransparency of the shell the external sculpture. Length 2$\frac{3}{4}$ millim., diam. 2, height 1.

Hab. On a stone dredged in a few fathoms in Niamkolo Harbour, south end of lake.

This is the first and only species of *Anclyus* known from the lake. The genus, however, occurs both in the north and south of the African continent, but with the exception of *A. stuhlmanni* Martens, from the Victoria Nyanza, no species have been recorded from the great lakes. Being so small it is possible they may have been overlooked.

Prof. Gwatkin, who has very kindly examined the radula, observes:—"As I expected, it belongs to the *A. parallelus* type, which I have from S. Africa, Australia, and North and South America. To it belong my 'Gundlachias' from Tasmania and New Zealand."

3. PLANORBIS SUDANICUS Martens.

Hab. Swamp at Mbete, south end of lake.

4. NEOTHAUMA TANGANYICENSE Smith.

Hab. Kituta, Kala, Moliro, Sumbu, Kalambo.

Keeled and non-carinate specimens were found together at the south end of the lake by Dr. Cunnington, so that Mr. Moore's idea of the local distribution of this species appears to be, in a measure, incorrect.

5. AMPULLARIA OVATA Olivier.

Hab. South end of lake.

6. UNIO BURTONI Woodward.

Hab. South end of lake, and Kala at south end of east coast.

7. BURTONIA TANGANYICENSIS (Smith).

Hab. Kombe, east coast below the middle, and south end of the lake.

8. PLEIODON SPEKEI Woodward.

Hab. Sumbua, east coast.

9. **BRAZZÆA ANCEYI** Bourguignat.

Hab. Kibanga.

One valve only, with five or six radiating ridges down the anterior end.

c. POST-PLIOCENE SPECIES.

Some shells of species still living in Tanganyika were found embedded in a coarse sandy matrix upon the shore at Sumbua, about halfway up the east coast of the lake. One reef was so weathered that the shells (*Neothauma*) stood out very conspicuously, just in the breakers. Three similar reefs occur at intervals inland, on the summits of the former sandy beaches. These shells may be referred to a late Post-Pliocene age. Other specimens occurred in a cliff or ridge, about six feet high, in the north-west part of the Rukwa Valley, where the lake formerly was, but is now dried up.

So far as one can judge, none of the shells which are more or less perfect, or of those of which there are only fragments, belong to other than recent species, showing that these ridges are of quite modern origin.

Among those from Sumbua, besides the *Neothauma*, are remains of *Rumella*, a thalassoid genus, and of *Unio*; and from the Rukwa Valley are fragments of *Lanistes*, *Vivipara*, *Melania*, *Corbicula*, and *Unio*, all ordinary freshwater types. The amount of material at hand, however, is so small, that one cannot say to what extent the thalassoid shells may be represented in the same locality.

II. *Species from the Victoria Nyanza.*

The following species were obtained by Dr. Cunnington at Bukoba on the west shore of the Lake.

1. **PLANORBIS SUDANICUS** Martens, var. **MINOR** Martens.

Hab. On water-weed in shallow-water inlet north of the town.

2. **PLANORBIS CRAWFORDI** Melville & Ponsonby.

Hab. Same as that of preceding species.

Two specimens were obtained, which appear to be inseparable from this species described from Cape Colony.

3. **MELANIA TUBERCULATA** (Müller).

Hab. Taken in shrimp-net in a few feet of water in the harbour.

4. **VIVIPARA CONSTRICTA** Martens.

Hab. Dredged in about a fathom in the harbour.

The specimens of this very variable species from this locality are rather like Martens's figure ('Beschalte Weichthiere Deutsch-Ost-Afrika,' vol. iv. pl. vi. fig. 20), but they exhibit a third keel between the two represented in the illustration. They are more strongly spirally striated than other examples which have been examined.

5. UNIO LOURDELI Bourguignat.

Hab. Dredged in about a fathom in the harbour.

6. CORBICULA CUNNINGTONI, sp. n. (Plate X. fig. 15.)

Shell small, irregularly ovate, almost equilateral, moderately convex, sculptured with rather distinct and distant concentric ridges, which become almost obsolete on both dorsal slopes; valves yellow olivaceous, with or without a few brownish rays, more or less deep purplish within; umbones prominent. Length 12¼ millim., diam. 8, height 11.

Hab. Dredged in about a fathom in the harbour.

This species may be separated from *C. radiata* Parreyss, the only species recorded from the Lake, on account of its somewhat different form, the umbones being more prominent, the more distant concentric ridges, and a difference in colour. None of the specimens exhibit the characteristic dark purple ray proceeding from the umbo down the middle of the valves as in *C. radiata*. Two out of three examples have little or no trace of markings, but the third is distinctly rayed with brown, the rays being different in the two valves.

7. SPHÆRIUM VICTORIÆ, sp. n. (Plate X. fig. 16.)

Shell roundly subovate, nearly equilateral, greyish yellow, with numerous radiating dark hair-like lines; valves thin, finely concentrically striated with the lines of growth, which are crossed by minute microscopic radiating striæ which are quite invisible to the naked eye; interior dirty bluish; lateral teeth delicate.

Length 9¾ millim., diam. 5⅓, alt. 8¼.

Hab. Dredged in about a fathom in the harbour.

Larger than *S. nyanzæ* Smith, not quite the same shape, different in colour, rayed, and with more delicate hinge-teeth.

8. ÆTHERIA ELLIPTICA Lamarck.

Hab. Entebbe, north-west end of the lake.

EXPLANATION OF PLATE X.

Figs. 1, 2, 3. *Bythoceras iridescens*: p. 182.
4. „ *minor*: p. 182.
5, 6, 9. *Paramelania damoni*: p. 182.
7, 8. „ *crassigranulata*: p. 182.
10. *Lavigeria grandis*: p. 182.
11. „ „ operculum.
12. *Anceya rufocincta*: p. 183.
13. *Giraudia horei*, operculum: p. 183.
14. „ *præclara*, operculum: p. 183.
15. *Corbicula cunningtoni*: p. 186.
16. *Sphærium victoriæ*: p. 186.
17, 18. *Ancylus tanganyicensis*: p. 184.
19. *Edgaria nassa*, operculum: p. 182.

PROCEEDINGS

OF THE

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OF THE

ZOOLOGICAL SOCIETY

OF LONDON.

1906, pp. 1–462.
(JANUARY—APRIL.)

PRINTED FOR THE SOCIETY,
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MESSRS. LONGMANS, GREEN, AND CO,
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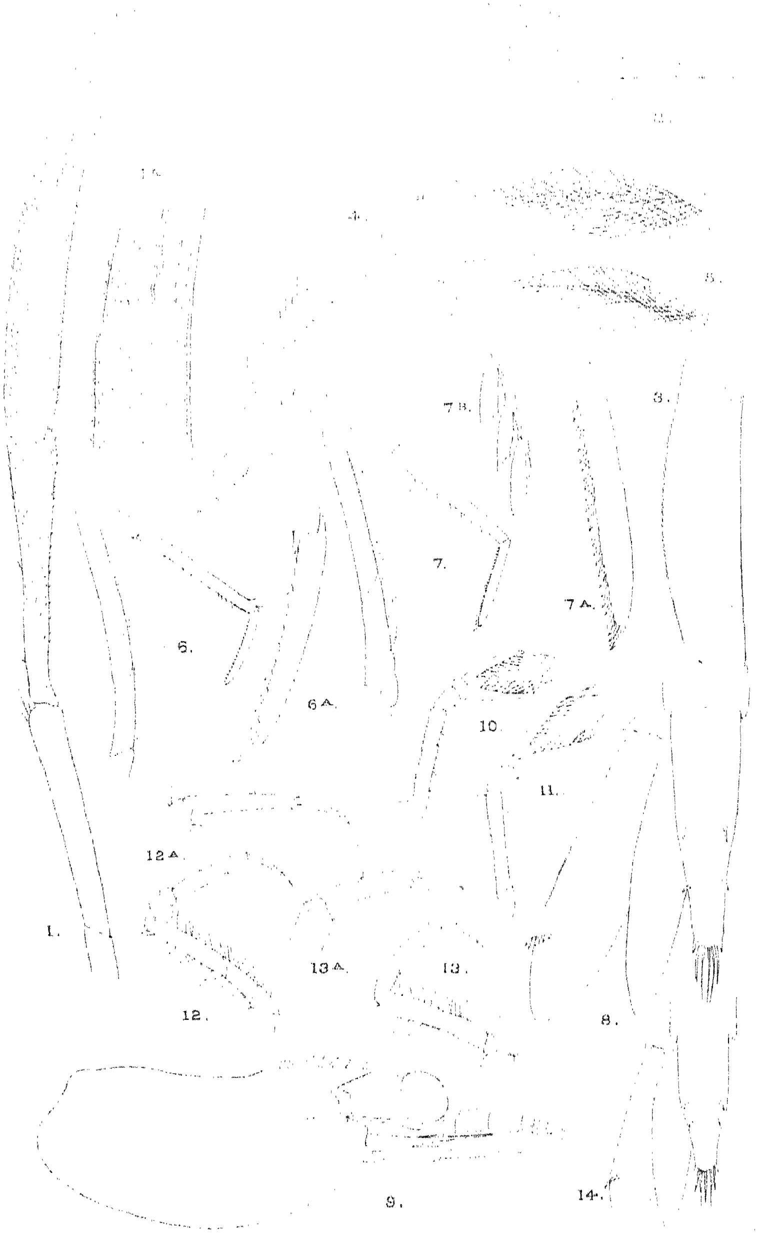
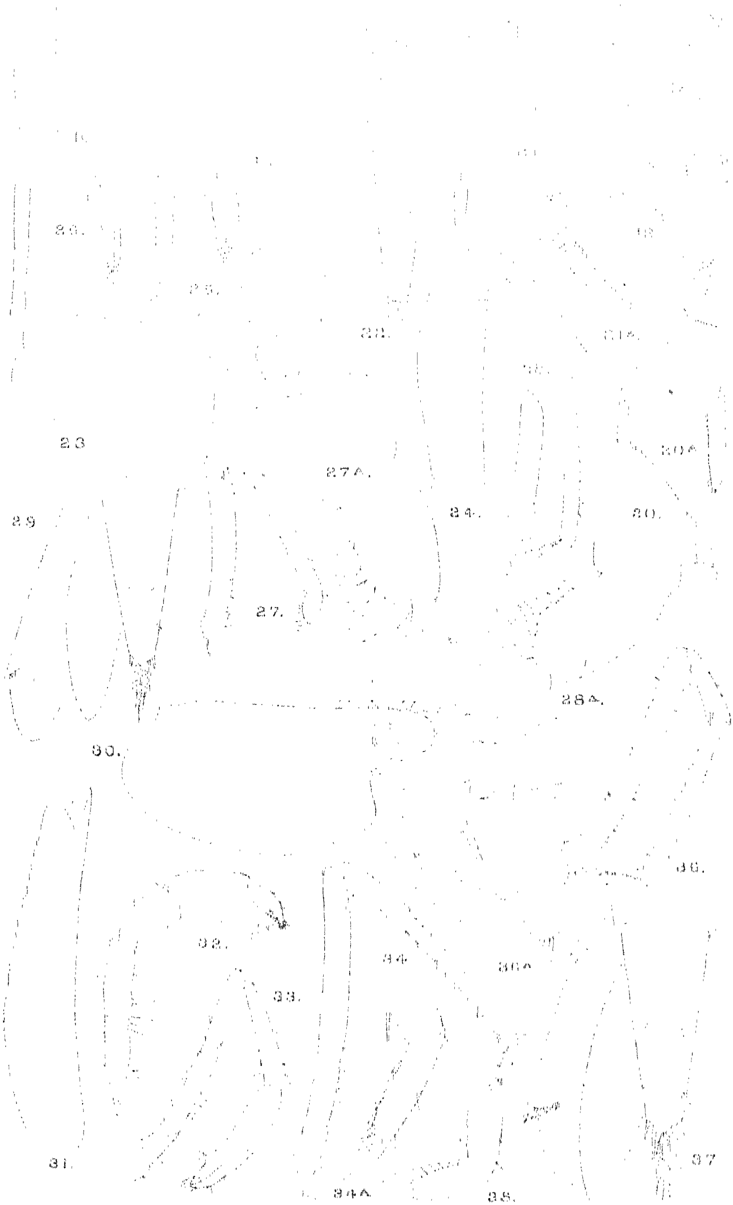
Mr. Arthur Thomson, *Assistant Superintendent of the Gardens.*



W.T.C. del.

Huth, sc. et imp.

1-1a. PALAEMON MOOREI.
2-8. LIMNOCARIDINA RETIARIUS.
9-14. L. PARVULA.



W.T.C. del.

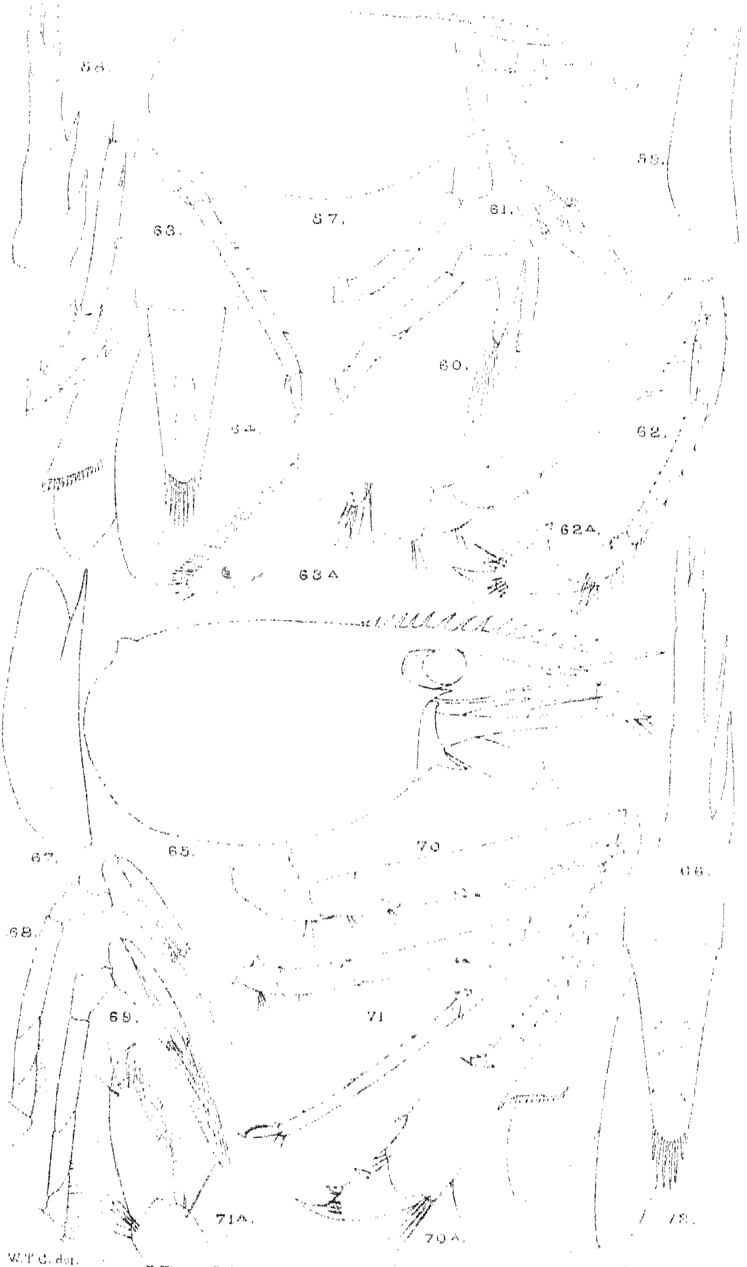
Huth, sc et imp.

15-22, LIMNOCARIDINA SIMILIS.
23-29 L. LATIPES. 30-37. L. SOCIUS.

W.T.C. del.

Huth lith. et imp.

38 – 44, LIMNOCARIDINA SPINIPES
45 – 52, CARIDELLA CUNNINGTONI.
53 – 56, C. MINUTA.



W.T.C. del.

57 – 64 ATYELLA BREVIROSTRIS
65 – 72 A. LONGIROSTRIS.

[illegible] imp.

2. Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905. Report on the Macrurous Crustacea. By W. T. Calman, D.Sc., British Museum (Natural History).

[Received February 5, 1906.]

(Plates XI.–XIV.*)

i. *Introduction.*

The collection of Macrurous Crustacea obtained by Dr. Cunnington from the lakes of Central Africa comprises thirteen species, of which only three have been previously described. In Nyasa and Victoria Nyanza only a single species was found, a common and widely-distributed form, already recorded from the latter lake. In Tanganyika, in addition to the two species discovered by Mr. Moore, Dr. Cunnington has been fortunate enough to find no less than ten new species, and among them representatives of what I regard as two new genera. The following is a list of the species obtained:—

Nyasa.
Caridina nilotica, var. *gracilipes* (de Man).
Tanganyika.
Palæmon moorei Calman.
Limnocaridina retiarius, n. sp.
,, *parvula*, n. sp.
,, *tanganyikæ* Calman.
,, *similis*, n. sp.
,, *latipes*, n. sp.
,, *socius*, n. sp.
,, *spinipes*, n. sp.
Caridella cunningtoni, n. g. et sp.
,, *minuta*, n. sp.
Atyella brevirostris, n. g. et sp.
,, *longirostris*, n. sp.
Victoria Nyanza.
Caridina nilotica, var. *gracilipes* (de Man).

I am obliged to Dr. Cunnington for giving me his notes on the occurrence and coloration of the various forms. These I have incorporated in their proper places. It is right that mention should be made of the excellent state of preservation of the specimens, and of the very careful and methodical manner in which the notes of localities and other particulars were kept.

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* For explanation of the Plates, see p. 205.

ii. *Systematic Notes and Descriptions of New Genera and Species.*

Family PALÆMONIDÆ.

PALÆMON MOOREI Calman. (Plate XI. figs. 1 & 1*a*.)

P. moorei Calman, Proc. Zool. Soc. 1899, p. 709, pl. xl. figs. 20–24.

The numerous and excellently-preserved specimens of this species which Dr. Cunnington has brought home enable me to add some further details to the description which I formerly gave. Of 18 specimens collected only two are males. This is a somewhat remarkable fact, since in this genus, as Coutière remarks, it is rare for the females to be as numerous as the males. The largest specimen is an ovigerous female, 27 mm. in total length. The males are a little smaller. The teeth of the rostrum are $\frac{2\text{-}3+7\text{-}11}{3\text{-}5}$. The second pair of peræopods in the females (Plate XI. figs. 1 & 1*a*) differ from those of the male formerly figured, and from those of the two males in the present collection, in having two low rounded teeth or tubercles on the inner edge of each of the fingers close to the proximal end. The males do not differ from the females in the length or stoutness of the chelæ. The carpus and hand are rough with minute sharp granules or spines, which were not well shown in the figure formerly given. There is some little variation in the relative lengths of the segments of this limb, as the following measurements (in millim.) show:—

	Merus.	Carpus.	Palm.	Fingers.
Female	4·0	4·5	3·6	3·9
,, ...	4·3	4·9	4·2	3·7
,, ...	4·7	5·0	3·5	3·9
,, ...	4·5	4·5	4·5	4·3
Male	2·9	3·3	2·5	3·0
,, ...	3·6	3·6	2·3	3·1

The mandible carries a palp which, although short (about half the length of the incisor process), is composed of three distinct segments, and in all other respects the species conforms to the definition of the genus* to which I have referred it.

As it is by no means easy to determine what are the affinities of this species among the very numerous and closely allied species of the genus, I have submitted a specimen to Dr. J. G. de Man, whose competence to pass judgment on this point will not be disputed. With his accustomed courtesy, Dr. de Man sent me a long letter dealing with the subject, and with his permission I quote some of his remarks. After noticing that *P. moorei* is, without doubt, the smallest species of the genus, and that it has, at first sight, quite the general appearance of some species of the genus *Caridina*, Dr. de Man goes on to say—"*P. sundaicus* Heller, with its varieties, does not seem to me to be the most nearly allied to *P. moorei* as you suggest. Like Coutière (Ann. Sci. Nat. 8^me^ sér. xii. p. 324), I think that *P. superbus* Heller and *P. trompi* de Man, especially the former, are the most closely allied species. *P. scabriculus* Heller and *P. alcocki* Nobili are apparently also related. All these forms, however, are in a greater or less degree different from your species. *P. trompi*, from Borneo, is at once distinguished by the few and large eggs, by the shape of the telson, the toothing of the fingers, &c. *P. scabriculus* differs in the carapace, which is scabrous, in the rostral teeth, of which six are set on the carapace, and in other characters. *P. alcocki* has the carpus of the second legs almost twice as long as the merus, and little shorter than the chela. *P. moorei* ought, in my opinion, to be considered as a distinct and interesting species."

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* I follow Ortmann, de Man, and the majority of recent authors in retaining the name *Palæmon* for this genus. I am unable to understand the reasons which have led some American authors to follow Spence Bate in using for it the name *Bithynis*.

To this I may add that *P. superbus* Heller, as re-described and figured by Coutière (*t. c.* p. 319, pl. xiii. figs. 34–37), grows to a very much larger size than *P. moorei*; and when specimens of about the same size are compared, it seems to differ in having the chelæ smooth and beset with rather long hairs. *P. niloticus* Roux, of which a specimen from the Blue Nile has recently been presented to the Museum by Captain Stanley Flower, clearly differs from *P. moorei* in many characters. It is of much larger size (the specimen before me is 41 mm. in total length); the rostrum has a strongly convex upper edge with eleven teeth, of which only one is on the carapace while the distal one is some distance from the tip; the lower edge of the rostrum bears two teeth (Klunzinger and Heller agree in giving the number as 1–2, so that Roux's figure, which shows five, is no doubt incorrect); the merus of the second legs is three-fourths of the length of the carpus, which is a very little longer than the chela; the fingers are about equal to the palm, and the whole limb is smoother than in *P. moorei*.

Occurrence.—Off Niamkolo, 12.viii.04. "Dredged in about 12 fathoms, among shells." About sixteen females and one male.

Kalambo, 4.xi.04. "Tow-netting, surface, 8.20 p.m." One very young specimen.

Kirando, 1.xii.04. "Taken in about 10 fathoms." One female.

Mrumbi, 27.xii.04. "From about 30 fathoms." One male.

Family ATYIDÆ.

CARIDINA NILOTICA, var. GRACILIPES (de Man).

C. wyckii, var. *gracilipes* de Man, in Weber's 'Zool. Ergeb. Niederländisch Ost-Indien,' ii. p. 393 (1891).

All the prawns obtained by Dr. Cunnington from Lake Nyasa and the Victoria Nyanza belong to the genus *Caridina*, and to that section of the genus including the forms to which the specific names *nilotica*, *longirostris*, and *wyckii*, as well as a series of varietal names, have been applied. It is not easy to determine what position the present forms ought to occupy within this group; and even if that question were satisfactorily answered, there would still remain room for discussion as to the appropriate name to be applied to them. It is generally agreed that Milne-Edwards's *longirostris*, described as coming from Algiers, but not since found there, is identical with the earlier *nilotica* described by Roux from the Nile. From de Man's re-examination of Milne-Edwards's types, we know that it has the carpus of the first chelipeds one and a half times as long as broad. From this Dr. de Man separates as a distinct species, under the name *C. wyckii* Hickson, those forms which have the first carpus at least twice as long as broad. Prof. Bouvier (Bull. Sci. France et Belgique, xxxix. p. 79, 1905) has pointed out, however, and I can confirm the statement, that co-types of Prof. Hickson's species, from Celebes, have the carpus exactly as in the types of *longirostris*. Specimens received from Prof. Hickson, and preserved in the British Museum, agree very closely indeed with de Man's description of his *C. nilotica*, var. *minahassæ* (also from Celebes), differing chiefly in the shorter dactylus of the posterior peræopods, that of the fourth pair being less than one-fifth, and that of the fifth pair one-fourth of the corresponding propodus. It follows that, so far as the characters of the carpal segments are concerned, *C. wyckii* Hickson must be regarded as a synonym of *C. nilotica* Roux, while *C. wyckii* de Man, if it is to be regarded as distinct, must receive a new specific or varietal name. Prof. Bouvier appears to regard de Man's species as merely a variety of that of Roux and Milne-Edwards (*t. c.*, table on p. 73; on p. 79, however, he treats it as a separate species); and in this I am disposed to concur, although the material at my disposal is too scanty to enable me to form a definite opinion. At all events the specimens collected by Dr. Cunnington in Lake Nyasa and in Victoria Nyanza, while not agreeing exactly with each other or with any of the described forms, come sufficiently near to the variety *gracilipes*, which de Man places under the species *wyckii*, and Bouvier under *nilotica*; and I therefore record them under the latter name. The following particulars were found to agree in several specimens from each locality, ovigerous females being compared in each case:—

Nyasa.—Total length up to 21 mm. Rostrum reaching beyond antennal scale, teeth $\frac{1\text{-}2+21\text{-}27}{10\text{-}18}$, unarmed terminal part of upper edge much less than half its length; one or two sub-apical teeth, and, occasionally, an isolated tooth a little way back from the tip. Carpus of first peræopods two and a half times as long as broad, that of second pair more than five times as long as broad. Dactylus of fourth pair one-fifth of propodus or a little over, bearing 7–9 spines; that of fifth pair a little more than one-fourth of propodus, with about 33–38 spines. Eggs ·47 × ·27 mm.

Victoria Nyanza.—Total length up to 25 mm. Rostrum, except in one or two cases, reaching beyond antennal scale, teeth $\frac{2+16\text{-}21}{15\text{-}21}$, unarmed part of upper edge much less than half its length, one or two sub-apical teeth, and occasionally an isolated tooth as above described. Carpus of first peræopods not more than two and a third times as long as broad (in a series of specimens collected at Entebbe, by Mr. E. Degen, the carpus is only about twice as long as broad, sometimes a little less than twice). Carpus of second pair less than five times as long as broad. Dactylus of fourth pair a little more than one-fifth of propodus, with 8–11 spines; that of fifth pair more than one-fourth of propodus, with 37–50 spines. Eggs ·6 × ·37 to ·62 × ·4 mm.

Hilgendorf has recorded *C. wyckii* var. *gracilipes* from several localities in the Victoria Nyanza (Deutsch-Ost-Afrika, iv. (7) p. 36, 1898) and elsewhere in German East Africa. Prof. Bouvier, who does not quote Hilgendorf's work, records from Victoria Nyanza and from Doufilé (Dufli) on the Upper Nile (about 3° 31′ N. lat.) specimens which he regards as intermediate between the typical *C. wyckii* of de Man and the South African var. *paucipara* Max Weber. The eggs in the specimens collected by Dr. Cunnington are rather smaller than those which Prof. Bouvier records from Lake Victoria, and much smaller than in the typical *paucipara*, while in other respects, such as the number of spines on the dactyli of the ambulatory legs, they show no approach to *paucipara*.

Genus LIMNOCARIDINA.

Limnocaridina Calman, Proc. Zool. Soc. 1899, p. 704.

To this genus, hitherto represented by only a single species discovered by Mr. Moore, I refer six of the new species found by Dr. Cunnington. As originally defined, the genus was distinguished chiefly by the great reduction of the branchial system, by the presence of a "hepatic" instead of an "antennal" spine on the carapace, and by the characters of the first and second maxillæ and the first maxilliped. In all the species described below, the branchial formula agrees with that formerly given for *L. tanganyikæ*, and there is no epipod on the first maxilliped. The structure of the maxillæ is also essentially the same, though, in the second maxillæ, the middle lobe is sometimes more expanded than it is in *L. tanganyikæ*, but not overlapping the distal lobe. With regard to the spine on the carapace, however, the new species to be described below show that the difference between *L. tanganyikæ* and the species of *Caridina* is one of position, not of homology. The spine, which in *L. socius* and *L. spinipes* is in the same position as the "antennal" spine of *Caridina*, is clearly homologous with that which, in *L. latipes*, *L. similis*, *L. parvula*, and *L. retiarius*, corresponds with what I formerly described as the "hepatic" spine of *L. tanganyikæ*. In the following descriptions therefore I have abandoned the terms "antennal" and "hepatic," and speak simply of the "antero-lateral spine" of the carapace. In the original description of *L. tanganyikæ* it is stated that the carpus of the first peræopods is "slightly excavated distally on the inner side." While this is quite correct and holds good also for the new species described below, it should be pointed out that this very slight excavation, not visible from the outer side, is very different from the marked excavation of the anterior margin of the carpus found in most of the species, at least, of the allied genera. Since, however, the excavation is about equally slight in some of the species of *Caridina*, it does not seem advisable to include this character in the generic definition. In all cases the terminal brushes of setæ on the fingers of the chelæ are more scanty than in any species of *Caridina* which I have seen.

Key to the Species of Limnocaridina.

A. Fingers of chelæ five to seven times as long as the palm, with very long marginal setæ.	
a. Rostrum about equal to antennular peduncle........	*L. retiarius*, n. sp.
b. Rostrum less than half as long as first segment of antennular peduncle	*L. parvula*, n. sp.
B. Fingers of chelæ not more than twice as long as the palm; setæ not very long, confined to distal part.	
a. Length of sixth abdominal somite more than twice its depth.	
a. Rostrum much longer than the carapace, with 10–20 teeth below	*L. tanganyikæ* Calman.
b. Rostrum about equal to carapace, with 3–6 teeth below	*L. similis*, n. sp.
c. Rostrum less than one-third of length of carapace, unarmed below	*L. latipes*, n. sp.
b. Length of sixth abdominal somite little more than one and a half times its depth.	
a. Rostrum nearly equal to carapace; merus of last three legs with one spine	*L. socius*, n. sp.
b. Rostrum little more than half length of carapace; merus of last three legs with 2–3 spines	*L. spinipes*, n. sp.

LIMNOCARIDINA RETIARIUS, n. sp. (Plate XI. figs. 2–8.)

Description.—Body slender; sixth somite of abdomen a little shorter than the carapace, length more than two and a half times its depth. Rostrum (Plate XI. fig. 2) about equal to or a little shorter than antennular peduncle, two-thirds as long as carapace, decurved at base, then horizontal or slightly recurved towards tip, teeth $\frac{2\text{-}4+7\text{-}10}{0\text{-}3}$, unarmed above for nearly half its length from tip. Antero-lateral spine of carapace set well back from front edge. Antennular peduncle reaching to external tooth of antennal scale. Distal edge of scale (Plate XI. fig. 3) projecting beyond external tooth. Third maxilliped extending to end of second segment of antennular peduncle, exopod not longer than ischium, terminal segment slender but a little shorter than preceding segment. First peræopods (Plate XI. fig. 4) reaching to tip of third maxillipeds, breadth of carpus two-thirds of its length, chela about three times as long as carpus, palmar portion less than one-fifth of length of fingers. Second peræopods (Plate XI. fig. 5) reaching a little beyond first, breadth of carpus little more than two-fifths of its length; chela a little more than twice as long as the carpus, palmar portion about one-fifth of length of fingers. Fingers of both chelæ slightly spoon-shaped, bearing along the whole length of their opposed edges on the outer and inner sides a single row of very long flexible setæ regularly arranged; each seta has a double series of rather widely-spaced barbs. Last three pairs of peræopods not differing greatly in length, third pair not reaching tip of third maxillipeds; dactylus of third and fourth pairs (Plate XI. fig. 6) more than half the length of propodus, with 14 spines; that of the fifth pair (Plate XI. fig. 7) nearly two-thirds of length of propodus, with 26 spines. Telson (Plate XI. fig. 8) three-fifths of length of sixth abdominal somite. Outer plate of uropods longer than inner.

Total length, ♀, 13·8 mm. Eggs ·3 × ·18 mm.

Remarks.—This species is distinguished from all the Atyidæ hitherto described by the remarkable and beautiful armature of its chelæ. The setæ with which the fingers are furnished, instead of forming apical tufts as in other Atyidæ, diverge from the outer and inner edges of each finger. As far as can be seen in the preserved specimens, these setæ entirely prevent the fingers from being brought together, so that the chelæ cannot be used for seizing objects in the ordinary way. On the other hand, each chela forms a kind of double casting-net, no doubt very efficient in the capture of minute living prey. The great length of the dactylus of the posterior legs is also a characteristic feature. In the structure of the mouth-parts and in the branchial formula the species shows no important differences from the other members of the genus.

Occurrence.—Mbete, 1.x.04. "Taken in shrimp-net, shore-wading." Among 17 specimens there are only three females, one of which carries eggs.

LIMNOCARIDINA PARVULA, n. sp. (Plate XI. figs. 9–14.)

Description.—Body very slender; sixth somite of abdomen as long as the carapace, three times as long as deep. Rostrum (Plate XI. fig. 9) very short, less than half as long as first segment of antennular peduncle, expanded horizontally at the base; teeth $\frac{6\text{-}7+0\text{-}2}{0}$. Antero-lateral spine of carapace set more than twice its own length from front edge. Antennular peduncle reaching well beyond external tooth of antennal scale. Distal edge of scale projecting beyond external tooth. Third maxilliped extending to end of first segment of antennular peduncle, exopod longer than ischium, terminal segment shorter than preceding segment. First peræopods (Plate XI. fig. 10) reaching to end of penultimate segment of third maxillipeds, breadth of carpus less than two-thirds of its length; chela about three times as long as carpus, palmar portion about one-seventh of length of fingers. Second peræopods (Plate XI. fig. 11) reaching a little beyond first, breadth of carpus little more than half its length, chela two and a half times as long as carpus, palmar portion about

LIMNOCARIDINA LATIPES, sp. n. (Plate XII. figs. 23–29.)

Description.—Body slender; sixth somite of abdomen a little longer than carapace, length two and a half times its depth. Rostrum (Plate XII. fig. 23) less than one-third of length of carapace, much shorter than first segment of antennular peduncle, horizontal, teeth $\frac{1\text{-}2+2\text{-}4}{0}$. Antero-lateral spine of carapace set a little way back from front edge. Antennular peduncle reaching to external tooth of antennal scale. Distal edge of scale (Plate XII. fig. 24) projecting beyond external tooth. Third maxilliped hardly extending beyond first segment of antennular peduncle, terminal segment two-thirds the length of preceding segment. First peræopods (Plate XII. fig. 25) hardly reaching middle of penultimate segment of third maxilliped, breadth of carpus about one-half of its length; chela one and a half times as long as carpus, two and a half times as long as broad, palmar portion a little shorter than the fingers. Second peræopods (Plate XII. fig. 26) reaching a little beyond first, breadth of carpus less than one-third of its length, chela a little longer than the carpus, four times as long as broad, palmar portion a little shorter than fingers. Last three pairs of peræopods stout, third pair extending well beyond tip of third maxillipeds, fifth pair hardly reaching beyond base of penultimate segment of same. Merus and carpus of last three pairs each with a single spine; dactylus very short and broad, that of fourth pair (Plate XII. fig. 27) about one and a half times as long as broad, and one-fourth of length of propodus, armed with nine large spines; that of fifth pair (Plate XII. fig. 28) hardly twice as long as broad, a little more than one-fourth of length of propodus, with ten spines. Telson (Plate XII. fig. 29) little more than half the length of sixth abdominal somite. Outer plate of uropods a little longer than inner.

Total length 9·7 mm. Eggs ·25 × ·16 mm.

Remarks.—This small species is easily distinguished from the other members of the genus by its very short rostrum, and by the short and broad dactyli of the posterior peræopods. The spines of the dactyli are unusually large, and do not differ in size in the two sexes. According to Dr. Cunnington's notes, the colour of this species in life was "greenish, with red and yellow spots."

Occurrence.—Mbete, 29.ix.04. "Shallow water amongst rocks." Two specimens.

Near mouth of Lofu, 6.x.04. "Taken on rocks, shallow water." Four females and eight males.

Kalambo, 4.xi.04. "Tow-netting, 8.20 p.m." One specimen.

Tembwi, 2.i.05. "Taken on rocks, shallow water." Five specimens

LIMNOCARIDINA SOCIUS, sp. n. (Plate XII. figs. 30–37.)

Description.—Body stout; sixth somite of abdomen less than two-thirds of length of carapace, length about one and a half times its depth. Rostrum (Plate XII. fig. 30) a little longer than antennular peduncle, equal to or a little shorter than carapace, nearly horizontal, teeth $\frac{3-4+7-12}{4-9}$, those of dorsal edge rather long and slender, unarmed above for less than one-third of its length. Antero-lateral spine of carapace set close to front edge. Antennular peduncle distinctly shorter than antennal scale. Distal edge of scale (Plate XII. fig. 31) not projecting as far as the long external tooth. Third maxillipeds extending to end of second segment of antennular peduncle, terminal segment shorter than preceding. First peræopods (Plate XII. fig. 32) short and rather stout, not extending beyond middle of first segment of antennular peduncle, breadth of carpus about three-fifths of its length; chela about one and a half times as long as the carpus, about two and a half times as long as broad, palmar portion one and a half times as long as the fingers. Second peræopods (Plate XII. fig. 33) hardly reaching to end of first segment of antennular peduncle, breadth of carpus less than one-quarter of its length; chela little longer than carpus, more than four times as long as broad, palmar portion about equal to fingers. Third peræopods reaching beyond, fifth pair falling considerably short of tip of third maxillipeds. Merus and carpus of last three pairs each with a single spine; dactylus a little less than one-quarter of length of propodus, that of fourth (Plate XII. fig. 34) with seven, that of fifth (Plate XII. fig. 36) with thirteen spines. Telson (Plate XII. fig. 37) a little shorter than sixth abdominal somite. Outer plate of uropods shorter than inner.

Total length 12 mm. Eggs ·26 × ·17 mm.

Remarks.—This species was twice found in company with *L. spinipes*, which it resembles in the rather short stout body, in the position of the antero-lateral spine close to the front edge of the carapace, and in having the outer plate of the uropods shorter than the inner. It differs in the shorter rostrum, in the short fingers of the first chelæ, and in the presence of only one spine on the merus of the posterior legs. In the male, the spines on the dactyli of the third and fourth peræopods are somewhat stronger than in the female (Plate XII. fig. 35).

Occurrence.—Niamkolo Harbour, 7.ix.04. "Dredged in about 3 fathoms among shells." Many specimens.

Utinta, 5.xii.04. "Dredged in about 10 fathoms among shells." One specimen.

Kirando, 1.xii.04. "Taken in about 8 fathoms of water, among shells." One specimen.

LIMNOCARIDINA SPINIPES, sp. n. (Plate XIII. figs. 38–44.)

Description.—Body stout; sixth somite of abdomen less than two-thirds of length of carapace, length about one and a half times its depth. Rostrum (Plate XIII. fig. 38) reaching to end of second segment of antennular peduncle, one-half to nearly two thirds of length of carapace, horizontal, teeth $\frac{2\text{-}4+6\text{-}9}{2\text{-}4}$, unarmed above for one-fourth of its length. Antero-lateral spine of carapace small, set close to front edge. Antennular peduncle a little shorter than antennal scale. Distal edge of scale (Plate XIII. fig. 39) not projecting so far as the external tooth. Third maxillipeds not reaching to end of second segment of antennular peduncle, terminal segment a little shorter than preceding. First peræopods (Plate XIII. fig. 40) short and stout, not reaching middle of first segment of antennular peduncle, breadth of carpus about two-fifths of its length; chela one and a half times as long as carpus, two and a half times as long as broad, palmar portion slightly shorter than fingers. Second peræopods (Plate XIII. fig. 41) not reaching end of first segment of antennular peduncle, breadth of carpus one-fifth of its length; chela equal to carpus, about four times as long as broad, palmar portion little more than half of length of fingers. Third peræopods reaching well beyond, fifth pair falling short of tip of third maxillipeds. Merus of last three pairs with two, sometimes three, spines on distal part of the lower margin, carpus with two spines side by side. Dactylus in each case a little less than one-third of length of propodus, that of third pair (Plate XIII. fig. 42) with five, that of fifth (Plate XIII. fig. 43) with twelve spines. Telson (Plate XIII. fig. 44) a little shorter than sixth abdominal somite. Outer plate of uropods a little shorter than inner.

Total length 7 mm. Eggs ·25 × ·15 mm.

Remarks.—This species resembles the preceding very closely, but the distinguishing characters are constant in all the specimens examined.

Occurrence.—Niamkolo Harbour, 7.ix.04. "Dredged in about 3 fathoms, among shells." Two specimens.

Kirando, 1.xii.04. "Taken in about 8 fathoms of water, among shells." Many specimens.

Utinta, 6.xii.04. "Dredged in about 15 fathoms among shells." Twelve specimens.

Genus CARIDELLA, gen. nov.

Peræopods without exopods; carpus of first pair excavated distally, that of second pair not excavated; chelæ of both pairs with a distinct palmar portion. Epipods on the first three pairs of peræopods. No pleurobranchia on the last thoracic somite.

Type, *C. cunningtoni*, sp. n.

This new genus is intermediate to some extent between *Caridina* and *Limnocaridina*. It resembles the former in the general structure of the mouth-parts, in the presence of an outer plate on the first maxilla and of a minute epipod on the first maxilliped. It approaches *Limnocaridina* in the reduction of the branchial system and especially in the absence of the posterior pleurobranchia, while several of the gills in the anterior part of the branchial chamber are also absent or reduced to small vestiges.

It is extremely difficult to determine exactly the number of gills in species so small as those described below; and the following formula for *C. cunningtoni* is given with the reservation that some minute vestiges of gills may have been overlooked. The absence of the posterior pleurobranchia, however, as well as the absence of an epipod from the penultimate legs, are characters which it is comparatively easy to demonstrate and which seem to justify the establishment of the new genus.

Branchial formula of *Cardiella cunningtoni.*

	mxp. 1	mxp. 2	mxp. 3	per. 1	per. 2	per. 3	per. 4	per. 5
Pleurobranchiæ	0	0	0	1	1	1	1	0
Arthrobranchiæ	0	0	r.	0	0	0	0	0
Podobranchiæ	ep.	ep.	ep.	ep.	ep.	ep.	0	0

In the case of *C. cunningtoni*, the large and peculiar first pair of chelæ and the unarmed dactyli of the third and fourth pairs of legs are striking features. They are not shared by *C. minuta*, but owing to the small size of this species and the fact that only one adult specimen was found it has not been possible to make a complete examination of its characters, and it may yet prove to belong to a distinct genus.

CARIDELLA CUNNINGTONI, n. sp. (Plate XIII. figs. 45–52.)

Description.—Rostrum (Plate XIII. fig. 45) reaching nearly to end of second segment of antennular peduncle, less than half length of carapace, slightly deflexed, teeth $\frac{3\text{–}5+8\text{–}12}{2\text{–}5}$. Antennular peduncle (Plate XIII. fig. 46) reaching to end of antennal scale, second and third segments longer than broad, external spine of first segment reaching to end of segment, distal spine reaching to middle of succeeding segment. Distal edge of antennal scale (Plate XIII. fig. 47) hardly projecting beyond external tooth. Third maxilliped not extending to end of antennular peduncle. First peræopods (Plate XIII. fig. 48) very stout, reaching to about end of penultimate segment of third maxillipeds; merus produced as a blunt tooth above articulation of carpus; carpus less than twice as long as broad, distinctly excavated distally; chela more than one and a half times as long as carpus and much broader, less than two and a half times as long as broad; fingers a little shorter than the palm, gaping widely, a stout curved tooth at base of immovable finger fitting into a notch at base of dactylus, apical brushes scanty and short. Second peræopods (Plate XIII. fig. 49) slender, extending beyond tip of third maxillipeds; carpus about seven times as long as broad; chela shorter than carpus, nearly four times as long as broad, fingers one and a half times as long as the palm, a small tooth at base of immovable finger. Third peræopods a little stouter than fourth (Plate XIII. fig. 50); merus in both with three spines below; propodus about three and a half times as long as dactylus, which is unarmed except for the terminal spine. Dactylus of fifth pair (Plate XIII. fig. 51) one-third of length of propodus, with a comb of about 37 slender spines besides the stout terminal spine. Telson (Plate XIII. fig. 52) equal to sixth abdominal somite. Outer plate of uropods slightly shorter than inner, with a transverse row of about fourteen spines.

Total length 9 mm. Eggs ·45 × ·62 mm.

Remarks.—This species is at once distinguished from all other Atyidæ known to me by the structure of the first pair of chelæ. In the absence of spines other than the apical one on the dactyli of the third and fourth pairs of legs, it resembles the species described above as *Limnocaridina parvula*.

Occurrence.—Kala, 19.xi.04. "Taken on rocks, shallow water." One specimen.

Kirando, 1.xii.04. "Taken in about 8 fathoms of water among shells." Six specimens.

Utinta, 6.xii.04. "Dredged in about 15 fathoms, among shells." Many specimens.

CARIDELLA MINUTA, sp. n. (Plate XIII. figs. 53–56.)

Description.—Rostrum (Plate XIII. fig. 53) hardly reaching beyond first segment of antennular peduncle, about one-quarter of length of carapace, straight, teeth $\frac{0+4}{0}$. Antennular peduncle not reaching to end of antennal scale, second and third segments broader than long, external spine of first segment not reaching end of segment, no distinct distal spine. Distal edge of antennal scale projecting beyond external tooth. Third maxilliped extending beyond antennular peduncle. First peræopods (Plate XIII. fig. 54) very short and stout; carpus broader than long, strongly excavated distally; chela nearly three times as long as carpus and a little broader, about twice as long as broad; fingers two-thirds as long as the palm, slightly gaping; no tooth at base of immovable finger. Second peræopods (Plate XIII. fig. 55) more slender; carpus twice as long as broad; chela one and a half times as long as carpus, fingers a little longer than palm. Last three pairs of peræopods (Plate XIII. fig. 56) similar and rather stout; dactylus at least one-third of length of propodus, and little more than twice as long as broad, with eight strong spines of which the second, not the terminal one, is the largest. Telson equal to sixth abdominal somite. Outer plate of uropods slightly shorter than inner, with a transverse row of four spines.

Total length 4 mm. Eggs ·22 × 15 mm.

Remarks.—Owing to the very small size of this species, it is extremely difficult to determine its exact branchial formula, but I have satisfied myself that it has no pleurobranch on the last thoracic somite and that the epipods extend to the third peræopods. On these grounds I refer it provisionally to the genus *Caridella.* From the preceding species it is distinguished by the characters of the first peræopods and the well-armed dactyli of the third and fourth.

Occurrence.—Near mouth of Lofu, 6.x.04. "Taken on rocks, shallow water. Colour yellowish, with red spots; eggs green." One specimen, ovigerous.

Karema, 12.xii.04. "Tow-netting, surface, 8.30 p.m." Six immature specimens.

Genus ATYELLA, gen. nov.

Peræopods without exopods; carpus of first and second pairs excavated distally; chelæ without any distinct palmar portion. Epipods on the first three pairs of peræopods. No pleurobranchia on the last thoracic somite.

Type, *A. brevirostris*, sp. n.

This genus bears the same relation to *Caridella* that *Atya* bears to *Caridina*, differing in having the carpus of the second peræopods excavated and the palmar portion of the chelæ obsolete. Perhaps the comparison should be with *Ortmannia* (*Atyoida*) rather than with *Atya*, for the two fingers of the chelæ, the propodus and the dactylus, are not exactly alike, though the articulation between them is practically in a straight line with their opposed edges. In any case, the new genus is distinguished from both of those just mentioned by the reduced number of the branchiæ. In *Ortmannia potimirim*, the only species, so far as I know, which resembles the present genus in having no epipods on the penultimate pair of legs, Fritz Müller states that there are seven gills on each side, one above each of the five thoracic legs, one above the external maxilliped, and a very small one on the second maxilliped (Arch. Mus. Rio de Janeiro, viii. p. 166, 1892). The branchial formula for *Atyella* is the same as that given above for *Caridella*.

Referring to a bottle containing both the species described below, Dr. Cunnington notes that the specimens were "red in the dark, changing to light violet in the light; with red-brown setæ on the chelæ." Fritz Müller has described changes of colour in *Ortmannia* (*Atyoida*) *potimirim* (*t. c.* p. 155, also Kosmos (Stuttgart), Jahrg. iv. Bd. viii. p. 472, 1881).

ATYELLA BREVIROSTRIS, sp. n. (Plate XIV. figs. 57–64.)

Description.—Rostrum (Plate XIV. fig. 57) generally less than one-third of length of carapace, reaching just beyond end of first segment of antennular peduncle or nearly to end of second, slightly decurved, teeth $\frac{4\text{–}5+10\text{–}14}{1\text{–}4}$, those on upper edge extending nearly to tip. Antennular peduncle (Plate XIV. fig. 58) a little shorter than antennal scale; first segment equal to second and third together, external spine of first not reaching end of segment distal spine reaching middle of second segment. Antennal scale (Plate XIV. fig. 59) little more than half length of carapace, external spine not reaching beyond distal margin. Third maxillipeds reaching a little beyond tip of antennal scale, terminal segment a little longer than preceding. First and second peræopods not dissimilar in shape and size; first pair (Plate XIV. fig. 60) hardly extending beyond penultimate segment of third maxillipeds. Carpus of first pair nearly three quarters as broad as long, less than half length of chela; that of second pair (Plate XIV. fig. 61) hardly longer than broad, about two-fifths of length of chela. Third peræopods (Plate XIV. fig. 62) stouter than the following; merus with four spines on distal half of lower edge; propodus more than half as long as merus; dactylus, including terminal spine, a little more than one-fifth of propodus, with three spines on its lower edge. Fifth peræopods (Plate XIV. fig. 63) with propodus longer than merus; dactylus, including terminal spine, about one-fourth of propodus, with about 43 spines on lower edge.

Total length, female (not ovigerous) 13·5 mm.

Occurrence.—Mbete, 1.x.04. "Taken on rocks, shallow water." Many specimens.

Near mouth of Lofu, 6.x.04. "Taken on rocks, shallow water." Many specimens.

Kala, 19.xi.04. "Taken on rocks, shallow water." One specimen.

A very small specimen taken in a rock-pool at Kasakalawe, 4.viii.04, is referred with some doubt to this species.

ATYELLA LONGIROSTRIS, sp. n. (Plate XIV. figs. 65–72.)

Description.—Rostrum (Plate XIV. fig. 65) about five-sixths of length of carapace, equal to or a little longer than antennular peduncle, nearly horizontal, teeth $\frac{5+10\text{–}11}{3}$, unarmed above and below for one-third of its length from tip, teeth on upper edge becoming long and slender anteriorly. Antennular peduncle (Plate XIV. fig. 66) a little longer than antennal scale, first segment less than second and third together, external spine of first reaching beyond end of segment, distal spine reaching to end of second segment. Antennal scale (Plate XIV. fig. 67) about three-fourths of length of carapace, external spine hardly reaching beyond distal margin. Third maxillipeds not quite reaching tip of antennal scale, terminal segment equal to or a little longer than preceding. First and second peræopods similar to those of *A. brevirostris*; carpus of first pair (Plate XIV. fig. 68) five-eighths as broad as long, about half length of chela; that of second pair (Plate XIV. fig. 69) nearly three-quarters as broad as long, less than half as long as chela. Third peræopods (Plate XIV. fig. 70) considerably stouter than the following; merus with five stout spines, of which the first is one-third of length of segment from its proximal end; propodus less than two-thirds of length of merus; dactylus, including terminal spine, about one-fifth of propodus, with two spines on lower edge. Fifth peræopods (Plate XIV. fig. 71) with propodus longer than merus; dactylus, including terminal spine, one-fifth of propodus, with about 26 spines on lower edge.

Total length, female (not ovigerous) 15 mm.

Remarks.—This species is very similar to the preceding, but appears to be sufficiently distinguished by the longer rostrum, the longer spines on first segment of antennular peduncle, and the smaller number of spines on dactylus of last peræopods.

Occurrence.—Mbete, 1.x.04. "Taken on rocks, shallow water." Two specimens.

Kala, 19.xi.04. "Taken on rocks, shallow water." Two specimens.

iii. *General Remarks.*

So far as the Macrurous Crustacea are concerned, the chief result of Dr. Cunnington's Expedition has been to render still more striking the great richness and peculiar character of the fauna of Tanganyika as compared with that of the other lakes of Central Africa. While Nyasa and Victoria Nyanza have yielded only a single species which, with its varieties, has an enormously wide geographical range from the Nile (and perhaps Algiers) to Natal on the south, and to Queensland and New Caledonia on the east, every one of the twelve species found in Tanganyika is, so far as we yet know, peculiar to that lake. Of these, *Palæmon moorei* belongs to a genus having a very wide distribution in the fresh-waters of tropical regions; but while a number of species are known from East and West Africa, *P. moorei* is the only one yet found in the region of the great lakes. Apart from its very small size, the species does not present any very unusual or striking characters, and it is therefore impossible to attach any great importance, from the point of view of zoogeography, to its supposed affinities with other species. It may be noted, however, that all the species with which it is found possible to compare it closely are inhabitants of the East African and Oriental regions, and that the species from the Nile, while undoubtedly distinct, does not differ in such a way as to exclude the possibility of phylogenetic connection.

With the remaining eleven species, belonging to the Atyidæ, the case is very different. They represent three genera which, so far as is yet known, are peculiar to Tanganyika, and which differ from all the other genera of the family in having a smaller number of branchiæ. Whether this single common character indicates a phyletic connection between the three genera is doubtful. The resemblances between *Limnocaridina* and *Caridina*, and between *Atyella* and *Atya* or *Ortmannia*, would suggest that the reduction of the gills had taken place independently in the two cases. At the same time, Bouvier's very interesting discovery (C. R. Acad. Sci. cxxxviii. p. 446, 1904, and Bull. Sci. France et Belgique, xxxix.

pp. 57–134, 1905) that certain species occasionally present "mutations" leading at a single step from *Caridina* to *Ortmannia* and from *Ortmannia* to *Atya*, must be borne in mind as suggesting the possibility that the *Atya*-like characters of *Atyella* may have arisen independently in the Tanganyika forms. In any case, there can be no doubt that the Atyidæ of Tanganyika rank among the most highly specialised members of the family and are far removed from such primitive forms as *Xiphocaris* and *Atyaëphyra*.

When describing the two species of Prawns discovered by Mr. Moore in Tanganyika, I pointed out (Proc. Zool. Soc. 1899, p. 711)* that they threw no light on the general question of the origin of the Tanganyika fauna, inasmuch as they belong to groups which are characteristically inhabitants of fresh-water. Since then, in his book on 'The Tanganyika Problem' and elsewhere, Mr. Moore has claimed that the prawns belong to the "relict," or as he terms it "halolimnic," section of the fauna of that lake. He believes that the members of this section are distinguished by special resemblances to marine forms and by generally primitive characters. He supposes that they represent the descendants of marine species which reached their present habitat not later than the Jurassic epoch, when the present site of the lake was occupied by an arm of the sea.

It is necessary, therefore, to state definitely that there is not the smallest ground for supposing that the Macrurous Crustacea of Tanganyika have had such an origin. The groups to which they belong, the genus *Palæmon* and the family Atyidæ, are widely distributed in the fresh-waters of tropical regions, and the fact that representatives of both occur in Tanganyika is, in itself, no more surprising than the fact that representatives of both occur in the Upper Nile. Nor is it the case that the Tanganyikan species present such primitive characters as would bring them closer to the hypothetical marine stocks from which these groups have arisen. As regards the Atyidæ, at all events, the reverse is the case, for the Tanganyikan genera are in some respects the most specialised members of the family. What does distinguish the Macruran fauna of Tanganyika is the great number of species found within a limited and continuous area † and their distinctness, so far as we know, from all the species inhabiting adjacent regions. The explanation of these peculiarities is a very difficult problem and one which cannot be profitably considered apart from the similar problems presented by the other elements of the Tanganyikan fauna. For the present, however, the characters of the Macrura seem to me to point in the direction of some such explanation as that which has been suggested by Mr. Boulenger in the case of the fishes, namely, that the forms now inhabiting the lake are the result of divergent evolution and specialisation during a very long period while the lake was quite isolated.

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* In stating (*l. c.*) that the genus *Caridina* was not known to occur in West Africa, I overlooked Hilgendorf's description (SB. Ges. naturf. Freunde Berlin, 1893, p. 156) of a species from Togoland. Bouvier has since recorded a variety of the same species from the interior of the French Congo and from the neighbourhood of Lake Tchad.

† It has lately been suggested by Dr. F. Sarasin (C. R. Congrès Internat. Zool. Berne, 1904 (1905) p. 151) that the peculiar richness in Decapod Crustacea which distinguishes the fresh-waters of Celebes may be directly correlated with the poverty of the fish-fauna of that island. It is plain that this explanation cannot be applied to the case of Tanganyika, where the fish-fauna is remarkably rich.

EXPLANATION OF PLATES XI.–XIV.

Plate XI.

Fig. 1. *Palæmon moorei* (p. 188), second peræopod of female. Total length of body 27 mm. 1 *a*. Portion of same, further enlarged.
2. *Limnocaridina retiarius* (p. 192), female. Cephalothorax from the side.
3. ,, ,, female. Antennal scale.
4. ,, ,, ,, Peræopod of first pair.
5. ,, ,, ,, Peræopod of second pair.
6. ,, ,, ,, Peræopod of fourth pair. 6 *a*. Dactylus of same, further enlarged.
7. ,, ,, ,, Peræopod of fifth pair. 7 *a*. Dactylus of same, further enlarged. 7 *b*. Spines of dactylus.
8. ,, ,, ,, Tail-fan.
9. *Limnocaridina parvula* (p. 193), female. Cephalothorax from the side.
10. ,, ,, female. Peræopod of first pair.
11. ,, ,, ,, Peræopod of second pair.
12. ,, ,, ,, Peræopod of fourth pair. 12 *a*. Dactylus of same, further enlarged.
13. ,, ,, ,, Peræopod of fifth pair. 13 *a*. Dactylus of same, further enlarged.
14. ,, ,, ,, Tail-fan.

Plate XII.

Fig. 15. *Limnocaridina similis* (p. 195), female. Cephalothorax from the side.
16. ,, ,, female. Antennal scale.
17. ,, ,, ,, Peræopod of first pair.
18. ,, ,, ,, Peræopod of second pair.
19. ,, ,, ,, Peræopod of third pair, dactylus.
20. ,, ,, ,, Peræopod of fifth pair. 20 *a*. Dactylus of same, further enlarged.
21. ,, ,, male. Peræopod of third pair. 21 *a*. Dactylus of same, further enlarged.
22. ,, ,, female. Tail-fan.
23. *Limnocaridina latipes* (p. 196), female. Cephalothorax from the side.
24. ,, ,, female. Antennal scale.
25. ,, ,, ,, Peræopod of first pair.
26. ,, ,, ,, Peræopod of second pair.
27. ,, ,, ,, Peræopod of fourth pair. 27 *a*. Dactylus of same, further enlarged.
28. ,, ,, ,, Peræopod of fifth pair. 28 *a*. Dactylus of same, further enlarged.
29. ,, ,, ,, Tail-fan.
30. *Limnocaridina socius* (p. 196), female. Cephalothorax from the side.
31. ,, ,, female. Antennal scale.
32. ,, ,, ,, Peræopod of first pair.
33. ,, ,, ,, Peræopod of second pair.
34. ,, ,, ,, Peræopod of fourth pair. 34 *a*. Dactylus of same, further enlarged.
35. ,, ,, male (smaller specimen). Dactylus of fourth peræopod.
36. ,, ,, female. Peræopod of fifth pair. 36 *a*. Dactylus of same, further enlarged.
37. ,, ,, ,, Tail-fan.

PLATE XIII.

Fig. 38. *Limnocaridina spinipes* (p. 197), female. Cephalothorax from the side.
39. ,, ,, female. Antennal scale.
40. ,, ,, ,, Peræopod of first pair.
41. ,, ,, ,, Peræopod of second pair.
42. ,, ,, ,, Peræopod of third pair. 42 *a*. Dactylus of same, further enlarged.
43. ,, ,, ,, Peræopod of fifth pair. 43 *a*. Dactylus of same, further enlarged.
44. ,, ,, ,, Tail-fan.
45. *Caridella cunningtoni* (p. 199), female. Cephalothorax from the side. 45 *a*. An egg, drawn to same scale.
46. ,, ,, female. Peduncle of antennule.
47. ,, ,, ,, Antennal scale.
48. ,, ,, ,, Peræopod of first pair.
49. ,, ,, ,, Peræopod of second pair.
50. ,, ,, ,, Peræopod of fourth pair, terminal part. 50 *a*. Dactylus, further enlarged.
51. ,, ,, ,, Peræopod of fifth pair, terminal part.
52. ,, ,, ,, Tail-fan.
53. *Caridella minuta* (p. 200), female. Cephalothorax, from the side.
54. ,, ,, female. Peræopod of first pair.
55. ,, ,, ,, Peræopod of second pair.
56. ,, ,, ,, Peræopod of fifth pair. 56 *a*. Dactylus, further enlarged.

PLATE XIV.

Fig. 57. *Atyella brevirostris* (p. 201), female. Cephalothorax, from the side.
58. ,, ,, female. Peduncle of antennule.
59. ,, ,, ,, Antennal scale.
60. ,, ,, ,, Peræopod of first pair.
61. ,, ,, ,, Peræopod of second pair.
62. ,, ,, ,, Peræopod of third pair. 62 *a*. Dactylus of same, further enlarged.
63. ,, ,, ,, Peræopod of fifth pair. 63 *a*. Dactylus of same, further enlarged.
64. ,, ,, ,, Tail-fan.
65. *Atyella longirostris* (p. 202), female. Cephalothorax from the side.
66. ,, ,, female. Peduncle of antennule.
67. ,, ,, ,, Antennal scale.
68. ,, ,, ,, Peræopod of first pair.
69. ,, ,, ,, Peræopod of second pair.
70. ,, ,, ,, Peræopod of third pair. 70 *a*. Dactylus of same, further enlarged.
71. ,, ,, ,, Peræopod of fifth pair. 71 *a*. Dactylus of same, further enlarged.
72. ,, ,, ,, Tail-fan.

3. Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905.—Report on the Oligochæta. By FRANK E. BEDDARD, F.R.S., Prosector to the Society.

[Received February 12, 1906.]

The Oligochæta brought back by Dr. Cunnington from Lake Tanganyika, and which have been submitted to me for study, belong to four new species, which I name *Ocnerodrilus* (*Ilyogenia*) *cunningtoni*, *Alluroides tanganyikæ*, *Metschaina tanganyikæ*, and *Stuhlmannia inermis*. Of these the first two are types which are among those Oligochæta lying on the border-line between the purely aquatic forms, like the Lumbriculidæ, and the purely terrestrial earthworms, such as *Lumbricus*. Both these species have been obtained either from the depths of the lake or from the roots of plants growing on its margin. The two remaining species are Eudriline genera, like the majority of Ethiopian terrestrial Oligochæta; and, like the earthworms of Tropical Africa generally, they are semiaquatic in habit, dwelling in very wet places not far from the shores of the lake.

Stuhlmannia inermis, sp. n.

A number of specimens of a worm dug up in the close neighbourhood of the shores of the lake from sandy mud seem to me to belong to an undescribed species of the genus *Stuhlmannia*.

The salient character of this species, viz., the occasional absence or, if present, feeble development of penial setæ, has suggested its name. At the same time none of the considerable number of examples collected by Dr. Cunnington is fully mature; so that it is conceivable that the penial setæ are as yet undeveloped. Nevertheless this view seems to me to be unlikely. The penial setæ are often visible in earthworms when other parts of the sexual organs are in a comparatively undeveloped state. On the latter view therefore I venture to regard the species as new, for it seems hardly likely that of three individuals selected at random for anatomical study the penial setæ should be fortuitously absent or lost in the course of the dissection or the preparation of microscopic sections. In one specimen, however, they were present, but feebly developed. They are hollow in transverse section.

The genus *Stuhlmannia* is one of the most prevalent African genera of Eudrilidæ, and the present species does not differ from the numerous examples of other species which I have had the opportunity of examining in the general outward appearance. It is a long thin worm of about the size of *Stuhlmannia variabilis*. The largest example measured 138 mm. All of the specimens were immature and showed neither clitellum nor a penis. The spermathecal and the atrial pores were, however, plainly visible and separable from each other by their characters as well as, of course, by their position. The spermathecal pore on the xiiith segment was on a raised protuberance. The atrial pore on the boundary-line of segments xvii./xviii. was a raised protuberance with a crater-like depression in the middle. The ventral setæ of the xviith segment were missing, otherwise both pairs are present in the genital region as elsewhere. The oviducal pores are to the inside of the lateral pair of setæ on the xivth segment. The setæ are closely paired and upon the ventral surface of the body.

The colour of the worms (in formol) is a dark bluish purple, so general a hue among earthworms and the Eudrilidæ in particular.

The gizzard lies in segment v. The calciferous glands, which have the same rudimentary character as in other members of this subfamily of the Eudrilidæ (*Pareudrilacea*)*, extend from segment vi. to xii. inclusive.

The septa which lie between segments v./xii. are very thick; those which divide the two following segments are moderately thick and are at least distinguishable by their size from those which follow. It is noteworthy that the septa which enclose segment xiii. approach each other very closely in the middle of the body in immature examples which I have examined in glycerine after dividing them longitudinally. This is not infrequent in the ovarian segment of earthworms.

Although the female reproductive organs were more or less fully developed in two out of the five examples which I studied of this species, I am not able to give a complete account of their structure. There is, however, a median spermathecal sac which opens upon the thirteenth segment to the exterior. This is connected with an egg-conducting apparatus, as in other species of the genus.

It is largely the asymmetry of the female generative apparatus which leads me to refer the present species to the genus *Stuhlmannia*; though it is, of course, not this feature alone which has influenced me. There are obviously other points of similarity. In his account of both *Stuhlmannia variabilis* and *S. gracilis* Michaelsen has not noticed the asymmetry†. In examples of a species which I regarded as belonging to that species‡ I commented upon the fact that the receptaculum ovorum of one side of the body was rudimentary. In a more recent and more exhaustive account of the female reproductive system of the genus, and as I thought of the same species, viz. *S. variabilis*, I described at length§ the same series of facts. Still later I found‖ in a third species of the genus, viz. *S. michaelseni*, the same asymmetry.

There is some discrepancy in the three accounts given by me of the asymmetry which possibly are not real discrepancies. I have described in some cases the left and in others the right side of the apparatus as partly rudimentary. In the species which forms the subject of the present communication there is no doubt that it is the right side which is fully developed and the left receptaculum ovorum which is rudimentary. This agrees with my account of *Stuhlmannia michaelseni* and with my earlier statement as to the matter contained in the "Monograph." If there is an error I am not now able to rectify it. But I can say positively that in *Stuhlmannia inermis* I found the receptaculum to be rudimentary upon the left side of the body. The median spermathecal sac gives off a branch upon each side which passes round the intestine; but whether the two unite above or not, I am unable to say. The "bursa copulatrix," or terminal chamber of the spermathecal sac which opens directly on to the exterior, may or may not communicate directly with the chamber containing the ovaries. I have no evidence of the communication if it exists. But in any case the sac in which the ovaries lie is different from what is to be found in *S. variabilis**.

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* Beddard, Quart. Journ. Micr. Sci. vol. xxxvi., n. s.

† "Beschreibung der von Herr Dr. Fr. Stuhlmann auf Sansibar und dem gegenüberliegenden Festlande gesammelten Terricolen," Jahrb. Hamb. wiss. Anst. ix. (1891), and "Die Regenwürmer Ost-Afrikas," in Deutsch Ost-Afrika, Bd. iv.

‡ A Monograph of the Order Oligochæta (Oxford, 1895).

§ "On some Earthworms from British East Africa," P. Z. S. 1901, vol. i. p. 351.

‖ "On a new Genus and Two new Species, &c.," P. Z. S. 1903, vol. i. p. 212.

In the present species of *Stuhlmannia* the entire bursa copulatrix lies within a large sac, which reaches from septum to septum of the xiiith segment and completely roofs in the bursa. In this sac attached to the front wall of the segment I have found one ovary. There is no question here as in *S. variabilis* of a small sac enclosing the ovary and communicating by a slender duct with the spermathecal sac and its circumœsophageal diverticula. For this reason I regard *S. inermis* as a distinct species from *S. variabilis*.

Dr. Michaelsen's recently described species *Stuhlmannia asymmetrica* † is apparently not to be confused with the present species, as indeed the different habitat would lead one to infer. That species has no penial setæ at all. Considering that the specimens investigated by Dr. Michaelsen were in a more advanced stage of sexual maturity than those of *S. inermis*, penial setæ, if present, would have been surely visible in some at least of the many specimens in Dr. Michaelsen's hands. But there is, furthermore, the important difference that the asymmetry in Dr. Michaelsen's new species is carried to a greater extent than in that described here; for the oviduct, receptaculum, and ovary are entirely aborted on the left side of the body, the right hand efferent apparatus of the gonads alone remaining. This feature serves at once to differentiate the two species. Nor does there appear to be a sac surrounding the atrium of the spermatheca, and possibly derived from it, which contains the ovaries, as in the form which I name here *Stuhlmannia inermis*.

Michaelsen's species represents the last term in the series of species of *Stuhlmannia* in which asymmetry is developed.

Metschaina tanganyikæ, sp. n.

I feel obliged to form a new species for some specimens of an earthworm on account of various characters to which I shall refer in the course of the following description. It seems to belong to Michaelsen's recently instituted genus *Metschaina*.

This species is much like the *Stuhlmannia* just described, and, like that worm, was found in wet sand close to Lake Tanganyika. Its dimensions are rather less than those of the largest *Stuhlmannia inermis*, but quite as great as some individuals of the latter species. It has, too, the same bluish colour. I have examined this worm almost entirely by means of longitudinal

* See Beddard, P. Z. S. 1901, vol. i. p. 354, fig. 87.

† "Die Oligochaeten Nordost-Afrikas," Zool. JB. (Abth. f. Syst.) 1903, p. 467.

sections. The external characters were partly observed by the aid of a lens upon the uninjured worm. The species possesses—and this is quite unusual for an Eudrilid—dorsal pores. This peculiarity is, however, shared by *Platydrilus*, with which genus I cannot associate the present species. It is not mentioned in *Metschaina suctoria*. The setæ are strictly paired, and do not appear to differ in size anywhere. The male and female pores, each of them single, were quite obvious upon segments xiii. and xvii. The clitellum was undeveloped.

In the *alimentary canal* certain characters are to be noted which are useful in defining the species. The *gizzard*, as is so usually the case in the Eudrilidæ, lies in segment v. There are no additional gizzards at the commencement of the intestine, such as occur, for example, in *Lybiodrilus*. The intestine begins in segment xvi., and the transition between œsophagus and intestine is abrupt. The *intestine* is of greater calibre than the œsophagus. The development of the modified *calciferous glands* which characterise this section of the Eudrilidæ is very great, and I believe greater than in any species where they have been described. I find that they extend from segment v. to segment xv. inclusive. As to their structure, they would appear to be quite similar to those which I described in some detail a few years back*. In the type species of this genus, the only one known, the calciferous glands are less extensive, ending as they do in segment xii. The *anterior septa* are much thickened. The first of this series is that separating segments v./vi. The last separates xiii./xiv. The last two of these septa are not so very strongly developed as those lying in front of them; but they are, nevertheless, distinguishable from those which follow.

The last *pair of hearts*, as in the Eudrilidæ generally, but not apparently in *M. suctoria* †, lie in segment xi. It is, of course, by means of the *reproductive system* that the genera of Eudrilidæ are mainly to be distinguished. And it is for these reasons that I refer this earthworm to the genus *Metschaina*. Opening on to segment xiii. is a single median spermathecal pouch. This pouch extends back as far as the fifteenth segment, and the last bit of it has very thin walls, thus contrasting with the anterior thicker-walled portion. The pouch, as is generally the case, can really be separated into a terminal atrium which opens on to the exterior and the sac of thinner texture which follows upon this. This spermathecal sac seems to have no communication whatever with the rest of the female reproductive system. In this important point the present genus resembles *Eudriloides* only among other allied Eudrilids.

In front of the spermathecal sac and attached to the front wall of segment xiii. lies the *ovary* or ovaries. I noted only one. A remarkable fact about this gonad, as compared with the ovaries of at least some other earthworms, is the fact that the ripe or nearly ripe ova are not all to be found at or near the free edge of that gonad. I noted cells far on the way to become ripe ova at some distance in the interior of the gonad, and in front of these was a thick layer of germinal cells not far advanced along the same road.

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* "Oligochæta of Eastern Tropical Africa," Quart. J. Micr. Sci. *loc. cit.*

† Michaelsen, Zool. Jahrb. Abth. f. Syst. xviii. 1903, p. 465.

The *oviducts*, as in *Eudriloides* also, open freely into the cavity of the xiiith segment. This, however, is a character also shared by *Platydrilus*. But the present genus (if it be rightly elevated to distinct generic rank) does not show the connection between the oviduct and the spermathecal sac which exists in *Platydrilus**. The oviducal funnel is very extensive, more so than in a large number of Oligochæta. The upper lip is very long, extending dorsally into actual contact with the dorsal blood-vessel as it traverses the septum. The lower lip of the funnel is pushed into and, as it were, tucked away into the receptaculum ovorum, which lies on the opposite side of the septum in segment xiv.

The oviduct itself, instead of running a straight course to the oviducal pore in the xivth segment, projects forward into the cavity of segment xiii. as a loop enclosed in a continuous muscular sheath. This U-shaped region of the oviduct differs in no way in structure from the rest of the tube, which runs an approximately straight course. The oviduct, therefore, is like the sperm-duct of certain Eudrilids (e. g., *Stuhlmannia*), in that it passes through the septum xiii./xiv. and, instead of opening into segment xiii. and facing forwards, turns back and for the most part at least faces back again into segment xiv. We have, however, to consider the long tract of cubical epithelium which lies along the anterior face of septum xiii./xiv., extending up to the level of the dorsal vessel. That this is continuous with the actual indipping of the funnel of the oviduct is without doubt. At the same time it seems possible to compare this tract of epithelium with the egg-conducting apparatus of other Eudrilids. It represents, as I think, potentially part of the egg-conducting apparatus (the so-called spermatheca) of *Eudrilus*†. I have lately shown that the large sacs in that genus are a development of the septum dividing segments xiii./xiv., and that primitively the epithelium of the oviducal funnel is continuous with a layer of equally cubical epithelium which with the muscular wall behind it is evaginated into the xivth segment to form the sac in question. In early stages such as I studied it is not possible to draw a distinct line between oviducal funnel and the epithelium of this sac. An earlier stage still (which I did not find in *Eudrilus*) would be, I should imagine, a continuation of the epithelium over the septum without a trace of the evagination. This state of affairs is precisely what we have in the Eudrilid which forms the subject of the present remarks. I do not think, however, that it is a temporary stage, and that the ultimate product would be a sac or sacs like those of *Eudrilus*, and for the following reasons:—

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* Here I confirm Michaelsen, who queries the fact.

† "The Gonad of *Eudrilus*," P. Z. S. 1902, vol. ii. p. 89.

Firstly, *Metschaina tanganyikæ* has a definite spermathecal sac which I have already described; secondly, the worms which I have examined are near to maturity, and not in the very young stages described by me in *Eudrilus*. Thirdly (perhaps), there is no trace of any sac involving the ovaries. This argument will be clear if the comparison be made with the developmental figures in my paper upon *Eudrilus* quoted.

In comparing more exactly the female reproductive system of this genus with that of *Eudriloides*, to which it obviously bears a closer likeness than to that of any other genus of Eudrilid, there are differences to be noted. In *Eudriloides durbanensis*, for example, the oviduct, although, as in the present species, it perforates the septum dividing segments xiii./xiv. twice, depending, therefore, as a loop into segment xiii., has no muscular sheath and is a delicate tube as in so many earthworms. In the present species the oviducal tube is thickly ensheathed with muscular fibres. The *male organs* furnish the principal reason which leads me to refer this worm to the genus *Metschaina*. There are, contrary to what is found in *Eudriloides**, *two pair of testes*, which lie, of course, in segments x. and xi. The funnels are opposite to them. The funnels face the opposite wall of the segments into which they open. There is no turning round and facing back into the segment behind such as occurs in several Eudrilidæ. The sperm-ducts retain their individuality, and after perforating the sheath of the atria on each side open into the cæcal extremity of that gland.

The *two atria* or *spermiducal glands* are quite separate, though opening by the same external pore. The *penial seta* of each side is long and runs obliquely through two segments. I am unable to describe its pattern, as I could not reproduce the whole of it from the sections.

The *sperm-sacs* of this Eudrilid are, as is so often the case, attached to the front walls of segments xi. and xii.

The above-given account of this species justifies me, as I think, in regarding it as a new species of *Metschaina*. I do not, however, think it desirable to draw up a diagnosis for comparison with that given by Michaelsen for the other species of the genus, since I am unable to speak positively upon certain features of importance for systematic purposes. The principal points characterising the present species which I have ascertained appear to be the following:—The calciferous glands are more numerous. There are dorsal pores present. The actual form of the oviduct also is not as Michaelsen has described and figured it for *Metschaina suctoria*.

Ocnerodrilus (Ilyogenia) cunningtoni, sp. n.

Of this species several examples were preserved. They were found "swarming in great numbers round roots of water-weeds in shallow water." It will be obvious in the course of the following description that the worm is either rightly referred to this genus and subgenus or that it requires a new genus or subgenus for its reception on account of certain peculiarities which will be duly noted.

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* It must be recalled, however, that occasionally two pairs of testes have been found in an apparent *Eudriloides* (*cf.* Beddard, Q. J. M. S. xxxvi., n. s. p. 212).

A specimen which I have selected as the type (as regards external characters) measured 38 mm. in length and consisted of 96 segments. The *setæ* appear of considerable length in proportion to the diameter of the body. They are of the usual shape, but distinctly bifid at the tip, though it often happens that the upper half of the cleft extremity is worn down and the seta thus appears to be merely hooked. I believe that the existence of uncinate setæ is new to this particular group of Oligochæta.

The *clitellum* is not very extensive, occupying as it does segments xiv.–xviii. and commencing or ending, as the case may be, towards the middle of each of these segments. The clitellum is saddle-shaped. The *generative pores*, the actual orifices, are not very plain on the mounted specimen. But from serial sections I have ascertained that the *spermathecal pores* lie between segments viii./ix. and the *male pores* upon segment xvii.; the latter nearly in line with the ventral setæ, and the former near the lateral setæ. It is to be noted that both setæ of the ventral as well as the dorsal pair are present upon segment xvii. and that they are not in any way modified. The male pore on each side is just to the outside of the pair of setæ, and is borne upon a prominent flap which is not invaded by the clitellar epidermis. Its structure will be dealt with later.

The *alimentary canal* is without a gizzard. In the ixth segment the *œsophagus* is provided with a *ventral pouch*, which whether single or paired is so characteristic of the subfamily Ocnerodrilinæ. In the present species, however, this pouch, which is single, is greatly reduced in size and bifurcates into two after its emergence from the gut. Indeed, if it were much larger there would be, in view of the large size of the spermathecæ, hardly room for it in the ixth segment. It is a smallish sac lying ventrally to the œsophagus and narrowing at its junction with the œsophagus very anteriorly in the ixth segment. It has not a specially glandular appearance, and the lining epithelium is merely folded. There is no such complicated folding as occurs, for example, in *Gordiodrilus*. The ventral pouch of this species appears to be either an incipient or a degenerating structure. A largish blood-vessel is attached to the posterior end of each bifurcation. The *septal glands* of the present species extend back into the viith segment.

The *vascular system* is noteworthy on account of the extreme vascularity of the integument, which is equally obvious in the specimen mounted entire and in sections. This was especially plain in the anterior region of the body. If the capillaries do not actually penetrate the epidermis, they only cease just below it. But they appear to me distinctly to enter the epidermis itself.

As in other species, there are two pairs of strongly muscular hearts in segments x. and xi.

The *spermathecæ* are very large thin-walled sacs, occupying a large portion of the interior of segment ix. The duct of the spermatheca is very narrow and moderately long. I could find no diverticulum. The *testes* (two pairs) lie in segments x., xi. opposite to the conspicuous sperm-duct funnels. They are both unenclosed by sperm-sacs. These segments contain masses of developing spermatozoa, which suggest at first sight sperm-sacs. They are, however, unenclosed by any membrane.

The *sperm-sacs* lie in segments ix. and xii., and, as in other worms, are developed from the posterior and anterior walls of those segments respectively.

The male efferent apparatus conforms to the type seen in other species of this genus. The male pore, as has already been mentioned, is upon segment xvii. This pore is situated upon a prominent hemispherical papilla, which has not the structure of the adjacent clitellum, but consists of tall non-glandular cells, much taller than the cells of the non-clitellar regions of the integument and between which are no glandular cells. Both of the ventral setæ are present, and it is to the outside of these that the actual pore is to be found. There is a common pore for the atrium and the sperm-duct; but the two tubes are confluent only within the thickness of the body-wall. The atria extend back for a considerable distance behind their point of opening, for at least ten segments. The minute structure of the atria needs apparently no description; for they do not seem to differ from those of other species. It must be remarked, however, that the atria are distinctly divisible into the distal glandular region and a proximal thick-walled duct. There is a sharp differentiation between these two regions.

The *ovaries* occupy the usual position in the xiiith segment against the anterior wall of that segment. Opposite to them lie the funnels of the oviducts. The oviducts themselves perforate the body-wall and open to the exterior on the ventral side of the body, as already mentioned. It is noteworthy that an appreciable region of the oviduct is clearly formed by an invagination from the exterior; for it is distinctly lined with cuticle continuous with the cuticle covering the body. There is no receptaculum ovorum, and this absence I rather presume to be characteristic of this genus and not merely distinctive of this and other species. But although there is no receptaculum ovorum there is an incipient trace of the complicated system of sacs which involve the female reproductive organs in the more highly developed Eudrilidæ. This fact is important to note, inasmuch as there are some grounds for looking upon this primitive family or subfamily of Oligochæta, as Michaelsen regards it (which includes the genera *Kerria*, *Nannodrilus*, *Ocnerodrilus* and some others), as lying at the base of the Megascolecid series and as thus possibly effecting a junction with the highly specialised Eudrilids, which are regarded by Rosa and Michaelsen as forming one family with the Megascolecidæ. This point of view, to which I have not myself adhered in the past, is, I admit, strengthened by certain facts which I shall proceed to describe.

The ovary does not lie absolutely freely in the cavity of segment xiii. A sheath of delicate muscles is prolonged forwards as a tube which possesses a narrow lumen and opens finally by a mouth into the cavity of segment xiv. The lower edge of this mouth is thickened by an increased development of muscular fibre and calls attention to the tube. It appears to me that this tube is the equivalent of the delicate sac and tube leading from it which occurs in *Eudrilus* and in *Stuhlmannia* &c. (see my figure of the female reproductive system of *Eudrilus* in P. Z. S. 1902, vol. ii. p. 93, and of *Stuhlmannia* ibid. 1901, vol. i. p. 354). This tube leads from the sac which involves the ovary to the spermathecal sac. As the latter is developed at least in *Eudrilus* out of the intersegmental septum, and presumably in *Stuhlmannia* and other Eudrilids, there is no difficulty in comparing an open tube in *Ocnerodrilus* with a tube opening into a sac in *Eudrilus* &c.

I may conclude with a definition of this new species[*] :—

OCNERODRILUS (ILYOGENIA) CUNNINGTONI, sp. n.

Length about 38 *mm. Setæ strictly paired, bifid at extremity. Clitellum saddle-shaped,* xiv.–xviii. *Œsophageal pouch but little developed, bifid at end. Last pair of hearts in* xi. *Dissepiments* v./xii. *thickened. Sperm-sacs in* ix. *and* xii.*; masses of sperm in* x. *and* xi. *Atria rather long, extending in the direction of the tail, with a distinctly separated muscular duct. Male pores opening upon a papilla near to ventral pair of setæ, which are not aborted. Oviduct without receptaculum ovorum. Spermathecæ large and oval, with narrow duct, sharply marked off from pouch.*

Hab. Lake Tanganyika.

Alluroides tanganyikæ, sp. n.

Of this new species I am able to give but an incomplete account, as the collection contains but a single individual. This was mounted entire upon a slide in Canada balsam, and I can only therefore give an account of external characters and of a few internal features which were visible through the thin body-wall. I refer it to my genus *Alluroides*[†] by reason of the position and the structure (so far as I could make it out) of the reproductive organs, and it possesses no character which militates against this placing, as will be evident from the following details which I am able to give of its external and internal organisation. There will be equally no doubt from the facts which I shall relate that this Tanganyika worm is specifically distinct from *A. pordagei*.

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[*] I do not mention generic and subgeneric characters as defined by Michaelsen. I suspect, however, that the position of the last heart is a generic character, though not used by him.

[†] "A Contribution to our Knowledge of the Oligochæta of Tropical Eastern Africa," Quart. Journ. Micr. Sci. vol. xxxvi., n. s. p. 244.

Alluroides tanganyikæ is a more purely aquatic species than the type species of the genus; for it was dredged from about ten fathoms of water, whereas *A. pordagei* was found in the mud of a swamp. So far as I am aware, nothing further has been discovered about this genus since the publication of my own paper referred to above *. Dr. Michaelsen has, however †, from a consideration of the facts made known by me, placed the genus in a separate family, Alluroididæ. The new species to be described here necessitates no alterations in the family characters as given by Michaelsen, and a very slight change in the generic characters, which will be attended to after the description of *Alluroides tanganyikæ*.

This species is a small, slender, rather transparent worm, suggestive of a Lumbriculid, and, so far as I can recollect the latter, not very different in size from *Alluroides pordagei*. The single specimen is about 30 mm. long and not more than 1·5 mm. broad in the widest part of the body (anteriorly). It consists of 60 segments. The thinness and transparency of the worm, when viewed as a microscopic object, is distinctly that of a Limicolous Oligochæte.

The *prostomium* is rather long and pointed; it is divided by a constriction into an anterior and posterior half. It is longer than the first segment of the body, but is hardly to be separated from it dorsally. The first-marked constriction on the body separates the first two segments from each other.

The *setæ* are plain and of the ordinary pattern without a cleft extremity. They are strictly paired and present upon all the segments of the body with the exception of the first and that which bears the male pores, where the ventral pair are absent.

The boundaries of the *clitellum* were not distinguishable.

There is no external *penis*, but the partial immaturity of the specimen may be the cause of this. I only use it doubtfully therefore as a specific character.

It is mainly by reason of the position of the *generative apertures* that I place this species unhesitatingly in the genus *Alluroides*. The most anterior of these is a single widish aperture upon the boundary-line of segments viii./ix. The worm is sufficiently transparent to allow it to be seen that this orifice is continuous with a closed thick-walled sac, which seems to me to be obviously the spermatheca. The main fact to be considered about the *spermathecal pore* is that it is single and dorsal median in position. I believe that this state of affairs is unique. We find, however, frequent cases of the coalescence of two ventral pores to form one medianly situate ventral pore and a further coalescence of two spermathecæ, or, it may be, the disappearance of one. In comparing the present species with *Alluroides pordagei* we find that an analogous concrescence would appear to have taken place dorsally; for in that species the paired spermathecal orifices are placed close together and well to the dorsal side of the lateral setæ. The spermathecal pore has a tumid periphery and is very conspicuous.

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* See also 'A Monograph of the Order Oligochæta' (Oxford, 1895), p. 224.

† Oligochæta in 'Das Thierreich' (Berlin, 1900), p. 106.

The *male pores* are upon segment xiii. and upon the ventral surface of the body. They are in line with the ventral setæ, which are, however, absent upon that segment. These pores also are large and conspicuous. It will be observed that their position differs from that of the corresponding pores in *Alluroides pordagei*, which correspond to the lateral setæ and not to the ventral.

Concerning the *oviducal pores* I am unable to be certain, as I could not distinguish the oviducts themselves. I think, however, that I have detected them lying behind the male pores and in line with them upon the boundary-line of segments xiii./xiv.

The *alimentary canal* of this Annelid was plainly distinguishable throughout its course. I could see no gizzard, but septal glands were obvious. The œsophagus in the ninth segment acquires a coating of brown pigmented cells, which continue to the end of the body. From the ninth segment to the eighteenth inclusive the œsophagus is moniliform. From the nineteenth segment it is less so and somewhat wider. This region I regard as intestine. The transition from one region to the other is abrupt.

The *vascular system* appears to me to be arranged on the simpler plan characteristic of the aquatic families of Oligochæta. The dorsal, which is the larger, and the ventral vessels are connected by a pair of looped vessels, quite as in *e. g.* the Tubificidæ. Anteriorly I am unable to say anything about its relations, except that I could not trace the dorsal vessel forward beyond the large intestine and was quite unable to detect the *nephridia*.

The *spermatheca* is an oval sac which reaches back quite to the end of the ninth segment.

The *atria* end posteriorly in oval expansions looking very like spermathecæ. There are naturally two of them. They are directed posteriorly to the pores upon the xiiith segment.

In view of the facts brought forward here upon this new species of *Alluroides*, I venture to amend slightly the generic definition of Michaelsen and to distinguish the two species as follows:—

Genus ALLUROIDES Beddard.

Alluroides Beddard, Quart. Journ. Micr. Sci. vol. xxxvi. (n. s.) p. 252.

Small, slender, aquatic or semiaquatic Oligochæta with simple S-shaped setæ arranged in four pairs. Clitellum in neighbourhood of male pores. Alimentary canal without gizzard or glands. Meganephric with paired nephridia. Spermathecæ (or spermatheca) without diverticula opening between viii./ix. *at or near median dorsal line. Male pores on segment* xiii. *more or less ventral in position.*

Oviducal pores on xiii./xiv. *Sperm-ducts connected with long and coiled atria.*

(1) ALLUROIDES PORDAGEI Beddard, loc. cit.

About 25 *mm. in length. Spermathecal pores double, opening near dorsal median line. Male pores opening on level with lateral setæ. A penial process present on each side near to pores.*

Hab. Swamp on mainland opposite Mombasa, E. Africa.

(2) ALLUROIDES TANGANYIKÆ, sp. n.

About 25 *mm. in length. Spermathecal pore (and spermatheca) single, opening in middle dorsal line. Male pores opening on level with ventral pair of setæ, which are absent on this segment. No penial process* (?).

Hab. Lake Tanganyika in 10 fathoms.

4. Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905.—Report on the Porifera, with Notes on Species from the Nile and Zambesi. By R. KIRKPATRICK, F.Z.S.

[Received February 6, 1906.]

(Plates XV.–XVII.*)

Dr. W. A. Cunnington's collection of Freshwater Sponges includes eleven specimens, nine from Lake Tanganyika, one from the Victoria Nyanza, and one from Lake Nyasa.

The Tanganyika specimens, which are all in the form of thin incrustations on stones and shells, represent three species, viz. *Spongilla moorei* Evans, *Spongilla tanganyikæ* Evans, and a new species, which I have placed under *Spongilla*, and have named after Dr. Cunnington—*Spongilla cunningtoni*, sp. n.

The specimen from Victoria Nyanza belongs to *Spongilla carteri* Bowerbank, and that from Nyasa to *Spongilla biseriata* Weltner. Most of the specimens were obtained from quite shallow water, but some were dredged from 10 and 20 fathoms.

I would here take the opportunity of describing three other Freshwater Sponges from Africa, viz. a specimen from above the Victoria Falls, Zambesi, collected and presented to the British Museum by Mr. C. F. Rousselet, and belonging to a new species of *Spongilla*; a second one from the same locality, representing a new species provisionally placed under *Spongilla*, presented by Prof. A. Dendy; and, lastly, a new variety of *Ephydatia plumosa* Carter from the White Nile, presented by Mrs. H. Broun. Six species are now known from the Tanganyika area, four from the lake itself, viz. *Spongilla moorei* Evans, *S. tanganyikæ* Evans, *S. cunningtoni*, sp. n., and *Potamolepis weltneri* Moore; and two

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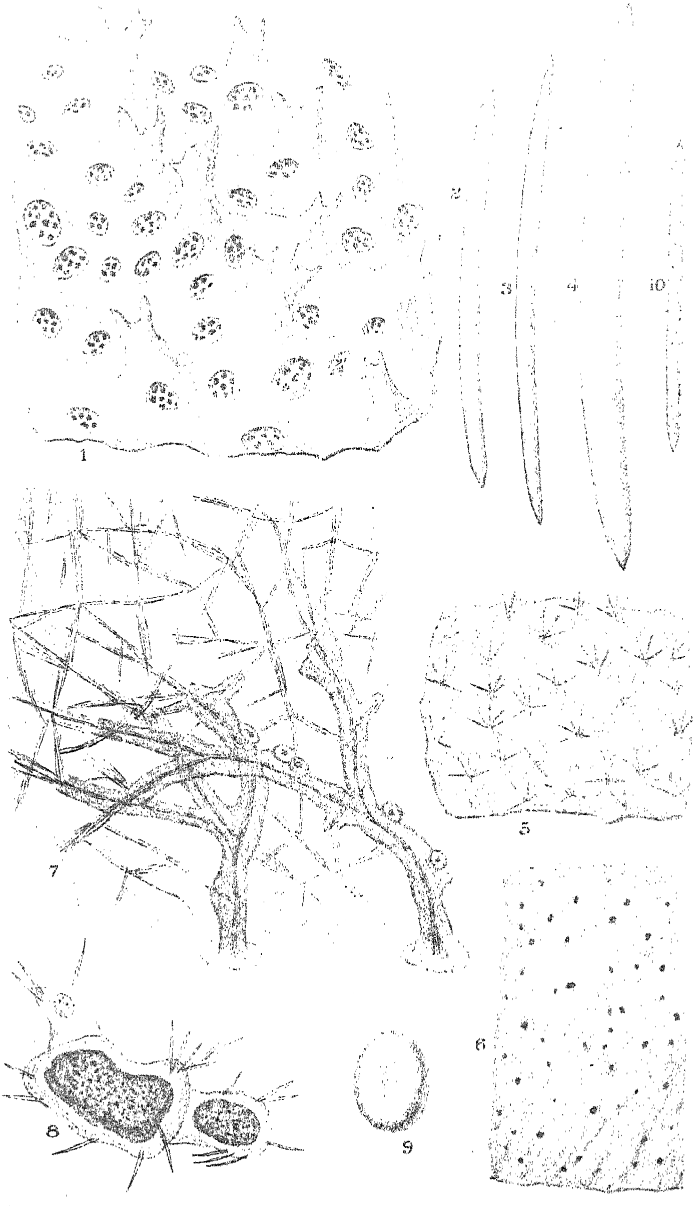
* For explanation of the Plates, see p. 227.

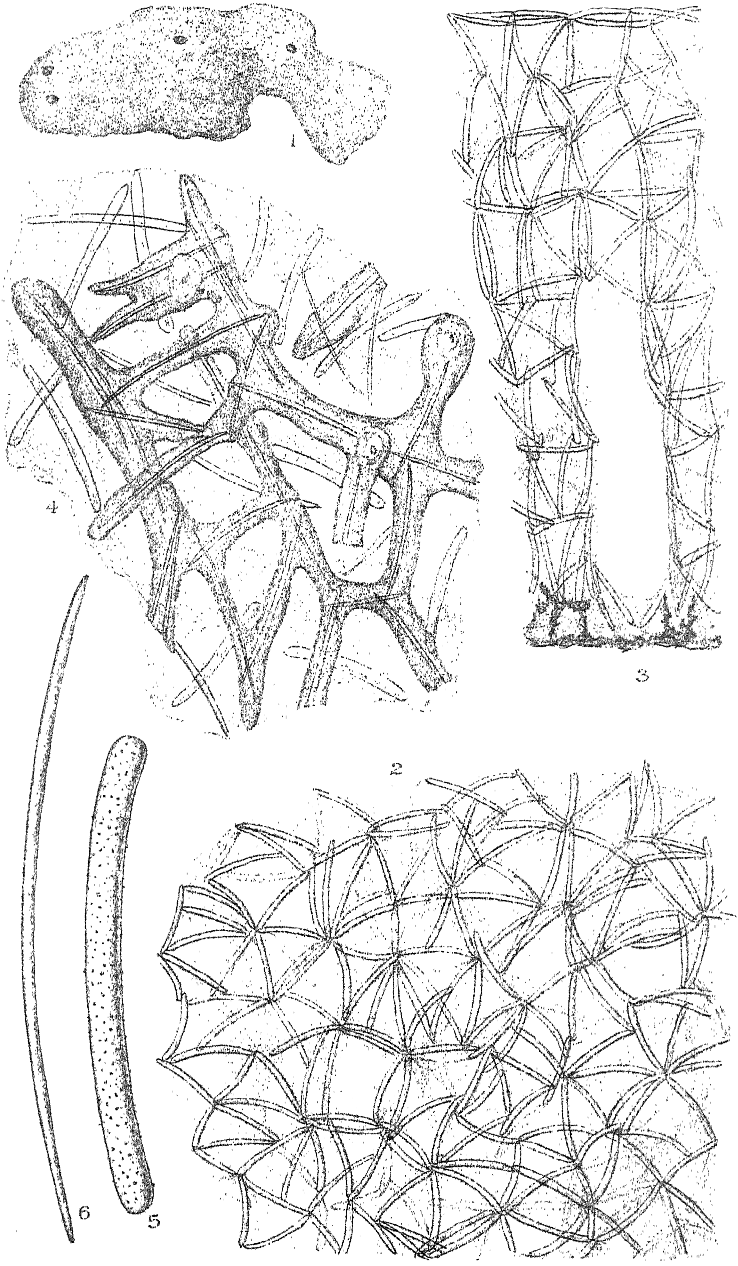


P. Highley del et lith.

Highley, imp.

AFRICAN FRESH-WATER SPONGES.

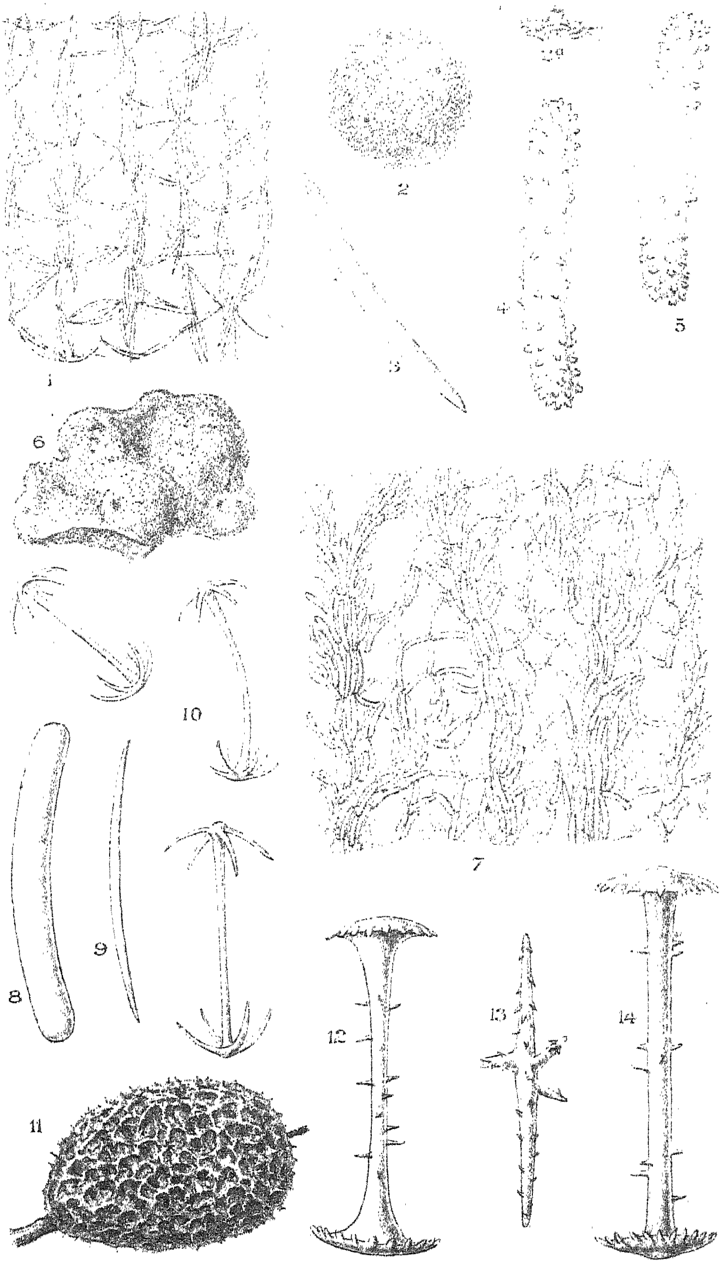
P. Z. S. 1906, vol. I. Pl. XVI.



P. Highley, del et lith.
Highley, imp.

AFRICAN FRESH-WATER SPONGES.

P. Z. S. 1906, vol. I. Pl. XVII.



P. Highley, del et lith.
Highley, imp.

AFRICAN FRESH-WATER SPONGES.

from the Ugalla River, a tributary of the Malagarassi River flowing into the lake, viz. *S. böhmii* Hilgendorf and *S. nitens* Carter.

The number of known species of African Freshwater Sponges is thus brought up to 19.

The following is a list of the species referred to in this paper:—

Spongilla carteri Bowerbank.	Victoria Nyanza.
Spongilla moorei Evans.	Tanganyika.
Spongilla tanganyikæ Evans.	Tanganyika.
Spongilla cunningtoni, sp. n.	Tanganyika.
Spongilla biseriata Weltner.	Nyasa.
Spongilla rousseletii, sp. n.	Victoria Falls, Zambesi.
Spongilla ? *zambesiana*, sp. n.	Victoria Falls, Zambesi.
Ephydatia plumosa Carter var. *browni*, nov. var.	White Nile.

SPONGILLA CARTERI Bowerbank. (Plate XV. figs. 1–4.)

1848. *Spongilla friabilis* Lamarck, Carter, Ann. Mag. N. H. (2) i. p. 310; 1849. Carter, *ibid.* (2) iv. p. 81.

1863. *Spongilla carteri* Bowerbank, Proc. Zool. Soc. 1863, p. 469.

1887. *Spongilla carteri* Potts, Proc. Acad. N. S. Philadelphia, 1887, p. 194.

There are two small specimens of this species, one of which has been removed from a piece of rock, the other from a shell of *Aetheria*. Unfortunately there are no gemmules present, but the characters of the surface and of the skeletal framework are those of Bowerbank's species. Plate XV. figs. 2, 3, 4 represent the oxeas* of specimens from the Victoria Nyanza, Bombay, and Mauritius respectively; it will be seen that the first (258 × 9·5 μ) is the smallest and has abruptly pointed almost tornote ends. The average size of the oxeas of the type specimen from Bombay is 287 × 11·75 μ and of the Mauritius specimen 349 × 18·5 μ. The thin dermal membrane, perforated by groups of pores, stretches between the sharp-pointed irregular conules formed by the ends of the longitudinal main fibres.

Localities.—Entebbe, Victoria Nyanza, shallow water. Bombay; Mauritius; Calcutta; Madura I.; N. Java; Lake Balaton, Hungary.

SPONGILLA MOOREI Evans. (Plate XV. figs. 5–9.)

1899. *Spongilla moorei* Evans, Quart. Journ. Micr. Sci. vol. xli. p. 472, pl. xxxvii. figs. 1–5, and pl. xxxviii. figs. 6–8.

There are five specimens of this species from five localities in Lake Tanganyika: three come from shallow water, and two from about 10 fathoms. They are all in the form of thin crusts from ½ to 1½ mm. thick on stones and shells, and none of them attains the size of the large nodulated type specimen obtained by Mr. J. E. S. Moore from deeper water in the same lake.

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* The terms "oxea," "tornote," "strongyle," clearly defined by Sollas in 1888 ('Challenger' Rep. Tetractinellida, pp. liv, lv), seem to me preferable to "amphioxea," &c., because, in addition to having claims of priority and brevity, they leave no doubt as to the form of the spicules they are intended to designate.

The colour varies: in the case of one specimen (No. 173), preserved in formalin, it is bright green. Dr. Cunnington gives yellowish grey as the colour of another; the rest are pale buff.

The surface appears very finely granulated to the naked eye. Under magnification this appearance is seen to be due to the little projecting tufts of the main columns of spicules, each tuft—about ·160 mm. in height—being formed of 2–5 spicules slightly curved away from each other; in the nearly related *Spongilla tanganyikæ* Evans the tufts are only 1–3 spicules thick, and the spicules are not separated at the distal end.

Skeleton.—There is some variation in the size of the megascleres. In several of the specimens they average about $160 \times 9\ \mu$, but in No. 142 they are more slender, being $150 \times 6\ \mu$.

An interesting feature which is found in this and in two other species, *Spongilla tanganyikæ* and *S. cunningtoni*, sp. n., from Tanganyika, lies in the presence of a basal lamella of spongin from which spongin fibres arise (Plate XV. figs. 6, 7).

In a small specimen (No. 593) preserved in picric acid, the spongin-lamella is especially well shown and the bases of the fibres can be seen through the lamella as dark round spots just visible to the naked eye. The spongin-lamella occurs also in another specimen taken from the smooth inner surface of broken Gasteropod shells (*Neothauma tanganyicensis*), where there could be no question of the presence of the horny layer found on the outer surface of freshwater shells. In the case of *Spongilla cunningtoni*, the specimen, which likewise has a basal spongin-lamella, was detached from a stone.

Plate XV. fig. 7 shows spongin-fibres enclosing a core of spicules. At a short distance from the basal lamella the skeleton-fibres have only a thin, barely visible, sheath of spongin. In *Euspongilla lacustris* also the basal skeletal fibres are ensheathed in spongin, which diminishes from the base upwards. This condition also is found in the Chalinidæ. In the marine Sponge *Chalina oculata*, for instance, the base of specimens is very rich in spongin, but near the summits of the branches scarcely any of this substance is perceptible, so that sections from the base and summit respectively might almost seem to anyone ignorant of their origin to belong to specimens of different species.

In addition to the fibres, there are masses or blobs of spongin enclosing granular matter: one of these ($780 \times 390\ \mu$) is shown in Plate XV. fig. 8.

The *gemmules* occur plentifully at the base of the crust in several of the specimens. They are oval and with a very thin naked chitinous coat, through which the large polygonal statocytes can be seen. On no part of the surface is there any special opening or area through which the contents escape.

Localities.—Lake Tanganyika. No. 113 from rocks, shallow water, Mbete, 29/9/04; No. 142, from rocks, shallow water, Moliro, 24/10/09; No. 161, from rocks, shallow water, Chamkaluki, 15/11/04 (gemmules plentiful); No. 173, from shells, dredged in 10 fms., Pembe, 23/11/04; No. 593, 10 fms., Mtondwe Bay.

SPONGILLA TANGANYIKÆ Evans. (Plate XV. fig. 10.)

1899. *Spongilla tanganyikæ* Evans, Quart. Journ. Micr. Sci. vol. xli. p. 481, pl. xxxviii. figs. 9, 10.

There are several small specimens, whole and in fragments, of this species in Dr. Cunnington's Collection. Two of the specimens (Nos. 163 and 224) are associated with Polyzoa, and although there are, in each case, only a few crumbling fragments, they are interesting, because in some respects they show an intermediate condition between *S. moorei* and the present species. The megascleres are spined as in *S. tanganyikæ*, but more nearly resemble the form of those of *S. moorei*. There are no strongyles, for instance, their place being taken by spined tornotes. Plate XV. fig. 10 shows a tornote on the way to becoming a strongyle; the sharp point of the oxea still persists, though it has nearly disappeared; its complete disappearance would result in the strongylate form. On account of the spined condition of the spicules I have classed the specimens under *S. tanganyikæ*. The remaining specimens are in the form of small incrustations on broken fragments of the shells of the Gasteropod *Neothauma tanganyicensis* together with incrustations of *S. moorei*.

Specimens of these two species so closely resemble each other externally that it is only possible to separate them by an examination of the spicules. The surface is uniformly level and finely granulated, the granular appearance being due here, as in *S. moorei*, to the minute projecting tufts of the main longitudinal spicule-bundles. The tufts only project the length of a spicule, and differ slightly from those of *S. moorei* in being composed of only 1–3 in place of 2–5 spicules, and in the spicules being adherent to each other along their whole length.

As in *S. moorei* there is a basal spongin-lamella, but it is very thin, nor are the spongin-fibres arising from it developed to the same extent as in the first species; at the same time, there are here also distinct spongin-fibres enclosing a core of spicules.

There are no gemmules in any of Dr. Cunnington's specimens. Those described by Evans in the type had only a thin chitinous capsule, and were apparently very like those of *S. moorei*.

Localities.—Lake Tanganyika, No. 163, associated with a Polyzoan, from rocks, shallow water, Chamkaluki, 16/11/04; No. 224, with Polyzoan, on shells, 20 fms., Mshale, 6/2/05; No. 593, dredged in 10 fms., Mtondwe Bay.

SPONGILLA CUNNINGTONI, sp. n. (Plate XVI. figs. 1–6.)

Sponge in form of a thin spreading crust. Surface smooth and devoid of projecting spicules. Skeleton a network with triangular and polygonal meshes, without distinct main and secondary fibres; dermal skeleton composed of a definite layer of horizontally arranged spicules. Spicules of two kinds, viz., thick, slightly curved, sparsely spined strongyles and longer, more slender, smooth strongyles. Gemmules?

Description.—Of the new species there are three small specimens in the form of thin crusts, the largest of which is 26 × 11 mm. in area and ·5–·7 mm in thickness. The crusts, which have been separated from stones, still retain the curvature of the surfaces on which they grew. Their consistence is flexible and elastic, so that when they are pressed flat they immediately resume their convexity when pressure is removed.

The surface is uniformly level, and in the dried condition has a glistening aspect, owing to the reflexion of the light from the tangentially disposed dermal spicules.

The oscules are nearly circular, and in the specimens quite level with the surface; but probably in the perfect condition each is surrounded by a slightly raised membranous rim, since traces of such a membrane still remain on one of the oscules. Each oscule leads into a shallow basin, whence the main exhalant canals radiate out horizontally.

The *skeleton* forms a network in which main and secondary fibres are not perceptible; the meshes (about 95 μ in diameter) are irregularly triangular and polygonal, the strands being from 2–3 spicules thick.

The dermal skeleton (Plate XVI. fig. 2) forms a lattice-work with triangular meshes, with strands 1–2 spicules thick formed of tangentially arranged spicules. Though the dermal layer is distinct, it is not easily separable from the parts beneath.

At the base of the sponge is a well-defined lamella of spongin (Plate XVI. fig. 4), whence arise thick horny fibres with a core of one or more siliceous spicules; the fibres attain a thickness of 38 μ. A short distance above the basal plate the spongin disappears, and the core of spicules is continued on into the general spicular network.

Spicules.—The strongyles with sparsely and finely granulated surface are 115–145 μ long and 5–6 μ broad, with the ends often, but not always, slightly and gradually enlarged (Plate XVI. fig. 5); occasionally also there is a central swelling.

The longer and more slender strongyles, 150–170 $\mu \times 2{\cdot}75\,\mu$, are smooth and taper towards the blunt rounded ends (Plate XVI. fig. 6).

There are no gemmules present in the specimens.

Affinities.—Although there are no gemmules present, and the megascleres are strongyles, I have placed the species in the genus *Spongilla*, rather than in *Uruguaya* (*Potamolepis*), because its affinities seem to be with certain species of *Spongilla*, viz. *S. böhmii* Hilgendorf*, *S. nitens* Carter, and *S. permixta* Weltner, in all of which there is a skeleton of strongyles. In none of these, however, are there two kinds of strongyles. In *S. loricata* Weltner, in addition to large strongyles (220–260 $\mu \times 20\ \mu$) there is a smaller kind of megascleres ($124\ \mu \times 7\ \mu$) with finely granular surface and swollen ends; here the very different sizes of the two kinds of spicules will at once serve to distinguish the respective species.

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* Possibly *Potamolepis weltneri* Moore ('The Tanganyika Problem,' 1903, p. 323) may be synonymous with *Spongilla böhmii*. I find the shape and size of many of the strongyles of the skeletal framework to be absolutely identical in the two species. Moore's figures (*l. c.* p. 323) of the spicules of *P. weltneri* are not quite correct, in

Locality.—From stones dredged in a few fathoms, Niamkolo Harbour, Lake Tanganyika.

SPONGILLA BISERIATA Weltner.

1895. *Spongilla biseriata* Weltner, Arch. Naturg. 1895, (1) p. 138.

1897. *Spongilla biseriata* Weltner, Deutsch-Ost-Afrika, Bd. iv. Die Coelenteraten und Schwämme des süssen Wassers Ost-Afrikas, p. 6.

1898. *Spongilla biseriata* Weltner, Mittheil. naturhist. Mus. Hamburg, xv. Beiheft, p. 1.

Dr. Cunnington's collection contains an example of this species from Lake Nyasa.

The specimen is in the form of an irregular clump about 4 cm. in diameter, growing round the stem of a reed. The sponge, which is in spirit, is dirty grey in colour, and is full of pale yellow gemmules.

An interesting additional fact to record is Dr. Cunnington's observation that the colour of this specimen was bright green when alive. The large dry type specimen from Cairo is described by Dr. Weltner as dirty white.

Localities.—From swamp, Karonga, Lake Nyasa, 2/7/04 (*Cunnington*). From a pool at Cairo (*Inez and Stuhlmann*).

SPONGILLA ROUSSELETII, sp. n. (Plate XVII. figs. 1–5.)

Sponge in form of a whitish incrustation.

Skeleton a network with longitudinal main and tranverse and oblique secondary fibres formed of bundles of oxeas with very little spongin.

Spicules curved oxeas, $214 \times 18{\cdot}5\,\mu$.

Gemmules spherical, with one or several pore-tubes, with a thick coat of spongin and with gemmule-spicules in form of spined micro-strongyles arranged tangentially in one or two layers.

Locality.—Above Victoria Falls, Zambesi. (Collected by Mr. C. F. Rousselet, Sept. 13, 1905.)

Description.—The new species is represented only by some small fragments of dirty-white colour. Mr. Rousselet, who kindly entrusted me with the material for description, informed me that

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that the general surface of the spicules is not smooth, but fine-spined or granular all over, just as in *S. böhmii*. There are no amphidisk flesh-spicules in the tiny scrap which represents, I believe, the type specimen of Moore's species. *S. böhmii* and *P. weltneri* both come from the same region, the former from the Ugalla River, a tributary of Tanganyika, and the latter from the lake itself. It would be well, however, to wait till more material is available for examination before deciding whether *Potamolepis weltneri* is a good species or otherwise.

"the specimen covered the submerged surface of a large stone to the extent of over a square foot in area; the crust was closely adherent and very thin."

The thickness of the crust is 2 mm. There are no oscules on the fragments of the specimen. The surface is level and provided with tufts of spicules ·16 mm. in height, formed by the ends of the main fibres.

The *skeleton* is formed of main longitudinal fibres about 6 spicules thick; at varying levels these fibres give off transverse secondary fibres 2–3 spicules thick, which meet the extremities of those from other main fibres; in parts where the main fibres are closer together the secondary bundles reach across from one main fibre to another, and the secondary bundles are thicker.

There are traces of a basal spongin-lamella in the form of broken scale-like fragments; but the spongin-fibres are reduced to mere cushions, into which the ends of the basal oxeas are immersed.

Spicules.—The megascleres are smooth curved oxeas $214 \times 18{\cdot}5\,\mu$, with subtornote ends; frequently with a central knob.

Micro-strongyles, scattered about in the tissues, are identical with those of the gemmules, and in all probability have belonged to those bodies.

The *gemmules* are spherical, 380–425 μ in diameter, with one, two, or three pore-tubes, each rising about 18 μ beyond the surface. The position of the pore-tubes varies, and when there are several they may be scattered over the circumference or close together. In one instance a pore-tube is thick-walled, closed at the end, and bent over.

The *gemmule-spicules* are micro-strongyles, arranged tangentially in one or two layers on the chitinous capsule. When there is only one layer, a tessellated or parquet-like pattern is discernible, each tessella being made up of a parallel row of 4–6 micro-strongyles, and fitting in with neighbouring tesselle at varying angles. When the layer is double it is difficult to make out any pattern; here and there the spined ends of the spicules project above the general level.

The strongyles are of two kinds: in one, $70 \times 12\,\mu$, the spicule is slightly curved, of nearly uniform diameter, spined all over with short blunt vertical spines, but less so in the centre; in the other, which is $65 \times 16\,\mu$, the centre is nearly smooth, swollen, and barrel-shaped, and tapering to the spined ends.

Affinities.—The gemmule-spicules somewhat resemble those of *Spongilla sumatrana* Weber, of which species Weltner describes two African varieties; in all these there are short spined micro-strongyles, but there are no flesh-spicules in the new species, and the megascleres are smooth, whereas in *S. sumatrana* and its varieties there are flesh-spicules and the megascleres are spined. *Spongilla permixta* Weltner from German East Africa, of which species only the gemmules are known, has spined microstrongyles for its gemmule-spicules, but these are much more slender, being only 3 μ in diameter, and with recurved spines.

In *S. biseriata* Weltner the oxeas of the skeletal framework are considerably longer and more slender, viz. 314 × 12 μ; likewise the microstrongyles are longer and thinner, being 80–96 × 4 μ.

The multiporal condition of the gemmule is found also in *Spongilla lacustris* var. *multiforis* Carter from British Columbia and the Yellowstone; at first Carter based a new species (*Spongilla multiforis*) on this character, but later considered the multiporal condition to be only of varietal importance.

SPONGILLA ? ZAMBESIANA, sp. n. (Plate XVII. figs. 6–10.)

Sponge in form of a thick, nodulated, hard crust or cake with irregular upper surface.

Skeleton a dense network with very thick main fibres and with secondary fibres.

Spicules.—Megascleres of two kinds, viz. (1) thick, smooth, slightly curved strongyles (180 × 24 μ), slightly and gradually swollen at the ends, forming the mass of the skeleton; and (2) a few slender, curved, smooth oxea, 170 × 7 μ. Microscleres amphidisk flesh-spicules, with slender stem ending in disks with usually four sharp recurved prongs; average dimensions:—length 33 μ, diameter of disks 13·5 μ, thickness of stem in centre 1·6 μ, at the ends 2·8 μ.

Gemmules ?

Locality.—Above Victoria Falls, Zambesi. (Collected by Miss Gibbs; presented to the British Museum by Prof. A. Dendy.)

The specimen on which the new species is based is in the form of a thick hard crust, 2·5 × 1·8 cm. in area and about 8 mm. thick. The rough surface is covered with a closely applied dermal membrane, in which, however, no pores are visible. There are several oscules 1 mm. in diameter scattered about.

The great main fibres of the skeleton are visible under a lens.

Permeating the sponge are several little white Chironomid larvæ, each surrounded by a sheath of spongin, which the sponge has secreted in self-protection. The spongin-sheath is crowded with the amphidisk flesh-spicules, and often has strongyles partly embedded. Sometimes the sheath encloses a mass of decayed sponge-tissue containing innumerable amphidisks. Some of these chitin-tubes are slightly branched, but they do not resemble true spongin-fibres, and do not seem to be proper to the sponge itself; but on this point I am not at all certain.

Affinities.—The hard consistence of the sponge and the possession of a dense skeleton constructed of thick smooth strongyles are characters of *Uruguaya* rather than of *Spongilla*; but in its skeletal arrangement and megascleres the new sponge closely resembles *Spongilla nitens* Carter; the latter species, however, has no amphidisks and its strongyles are longer and more slender, being 306 × 20·5 μ. Further, the new species comes near *Spongilla loricata* Weltner and *Spongilla böhmii* Hilgend., in both of which there are strongylate megascleres and amphidisk flesh-spicules.

The new form differs from all species of *Uruguaya* in possessing amphidisk flesh-spicules with toothed disks.

EPHYDATIA PLUMOSA Carter var. BROUNI, nov. var. (Plate XVII. figs. 11–13.)

This new variety is represented by a small nodule 1·5 cm. in diameter growing round a twig, collected on the banks of the White Nile on land previously submerged, about 200 miles above Khartoum, by Mrs. Hilda Broun.

The type specimens of the species were described by Carter, who found them growing on the sides of the freshwater tanks of Bombay, in which situation they were uncovered during six months of the year (Carter, Ann. Mag. N. H. 1849, (2) iv. p. 85).

In 1885 Potts described (Proc. U.S. National Mus. 1885, p. 587) a variety of this species (var. *palmeri*) from the Colorado River, N.W. Mexico, differing from the type in having spined megascleres. The Colorado River specimens occur in thousands suspended like wasps' nests on the drooping branches of the Screw Bean, and exposed for ten months in the year.

As Potts observes concerning the distribution: "That it should skip a whole hemisphere and only be found a second time at its own antipodes is indeed remarkable." Accordingly it is interesting to note an intermediate locality.

The example from the Nile resembles the Bombay specimens in having smooth megascleres, but differs from the latter in the characters of the amphidisks and stellate microscleres. In the Nile specimen the stem of the amphidisks is markedly curved and considerably thinner at the centre than at the ends; in the specimens from Bombay and Colorado R. the stem is straight and uniform in diameter. The stellate microscleres in the Nile specimen are almost or entirely devoid of a centrum and the rays are not capitate, whereas in the type these spicules have a well-marked centrum and the rays are capitate. The characters of the spicules of the three forms are tabulated below:—

	Oxeas.	*Amphidisks.*	*Stellate microscleres.*
Type specimen. Bombay.	425 × 16 μ. Smooth.	Length 62 μ. Diam. of disks 24 μ. Stem straight. Diam. of stem uniformly 4 μ.	With marked centrum; "rays" capitate.
var. *palmeri*. Colorado River.	325 × 12 μ. Spined.	Length 78 μ. Diam. of disks 27 μ. Stem straight. Diam. of stem uniformly 6 μ.	With slight centrum; rays not capitate; also other peculiar microscleres.
var. *brouni*. White Nile.	392 × 16 μ. Smooth.	Length 63 μ. Diam. of disk 24 μ. Stem curved. Diam. of stem at centre 4 μ. Diam. of stem at ends 6 μ.	Rays not capitate; without centrum.

Two species of *Ephydatia*, viz. *E. blembingia* Evans from the Malay Peninsula and *E. multidentata* Weltner from Queensland, resemble in many respects *E. plumosa*, but differ in being devoid of flesh-spicules.

EXPLANATION OF THE PLATES.

Plate XV.

Fig. 1. *Spongilla carteri* Bowerbank (p. 219), from Victoria Nyanza, surface. × 2.
2. Oxea of *S. carteri*, from Victoria Nyanza. × 210.
3. Oxea of *S. carteri*, from Bombay. × 210.
4. Oxea of *S. carteri*, from Mauritius. × 210.
5. *Spongilla moorei* Evans (p. 219), surface. × 44.
6. *Spongilla moorei*, under surface of basal spongin-lamella, with bases of spongin-fibres showing through. × 25.
7. *Spongilla moorei*, basal part of skeleton showing spongin-fibres with spicular core arising from detached portions of basal lamella. × 44.
8. *Spongilla moorei*, irregular mass of spongin with spicules partly embedded and enclosing granular matter. × 44.
9. *Spongilla moorei*, gemmule. × 25.
10. *Spongilla tanganyikæ* Evans (p. 221), spicule partly tornote, partly strongylate, × 425.

Plate XVI.

Fig. 1. *Spongilla cunningtoni*, sp. n. (p. 221). × 2.
2. Surface of the same. × 100.
3. Vertical section. × 100.
4. Basal spongin-lamella and fibres. × 160.
5. Strongyle. × 425.
6. Strongyle, long smooth kind. × 425.

Plate XVII.

Fig. 1. *Spongilla rousseletii*, sp. n. (p. 223), section. × 44.
2. Gemmule of same. × 44.
3. Oxea. × 210.
4, 5. Micro-strongyles. × 700.
6. *Spongilla? zambesiana*, sp. n. (p. 225). Nat. size.
7. Vertical section. × 44.
8. Strongyle. × 210.
9. Oxea. × 210.
10. Amphidisk flesh-spicules. × 700.
11. *Ephydatia plumosa* Carter, var. *brouni*, nov. var. (p. 226), specimen. × 2.
12. *Ephydatia plumosa* var. *brouni*, amphidisk. × 700.
13. Substellate microscleres of *E. plumosa* var. *brouni*. × 700.
14. *Ephydatia plumosa*, from Bombay (type), amphidisk. × 700.

5. A Note on "Flying" Snakes.

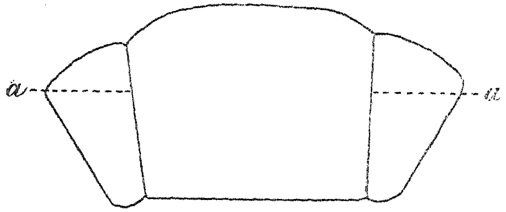
By R. Shelford, M.A., C.M.Z.S.

[Received March 6, 1906.]

(Text-figures 56 & 57.)

A large number of the Snakes of Borneo are almost entirely arboreal in their habits, spending much of their life in the branches of lofty trees and feeding on birds, birds' eggs, and tree-haunting lizards, such as *Calotes versicolor* and some of the geckos. That snakes can climb tree-trunks is well-known; and since in tropical jungles tree-trunks are more or less swathed in lianes and parasitic creepers, the climbing of them presents no special difficulty even to a limbless animal. Descent from a tree by way of its creeper shrouds, we may suppose, is even more easy, and is doubtless often resorted to. Some snakes, however, have been seen to hurl themselves from the top of a tree and to fall in writhing coils into water or bushes beneath; in the Sadong River, Sarawak, I captured a specimen of *Tropidonotus maculatus* Edel. that was swimming to shore after such a fall from a tree into the river. Individuals of three species have been observed to "fly" out of trees: namely, *Dendrophis pictus* Gmel., *Chrysopelea ornata* Shaw, and *C. chrysochlora* Reinw. My attention was first called to this habit by a Dyak collector attached to the Sarawak Museum, who brought in one day in 1898 a dead example of *Chrysopelea ornata*, and averred that he had witnessed this snake shoot out of a tree and descend to the ground at an oblique angle to the tree, its body being kept rigid the whole time of the "flight." Not unnaturally I gave but little credence to this statement, but my curiosity was stimulated when, some weeks later, a specimen of *C. chrysochlora* was brought in with the same story. Instructions to bring in these snakes alive were issued, with the result that before very long I was able to test on the living subject the truth of the Dyak's assertions. It must be noted here, that in these two snakes the ventral scales are provided with lateral sutures, or, as I prefer to call them, hinge-lines (text-fig. 56). If a living *Chrysopelea* be handled, it may be observed that, by a forcible muscular contraction, the ventral scales can be drawn inwards, so that the snake becomes deeply concave along the ventral surface (text-fig. 57, B); at the same time there is a slight dorso-ventral flattening of the body: each scale moves on its lateral hinge-lines; when the muscles working these scales relax, the snake re-assumes its ordinary cylindrical shape (text-fig. 57, A). In other words, during the muscular contraction the snake is like a piece of bamboo bisected longitudinally. As anyone can test for himself by experiment, a rod of bamboo will fall to the ground more quickly than a longitudinally bisected rod of equal weight;

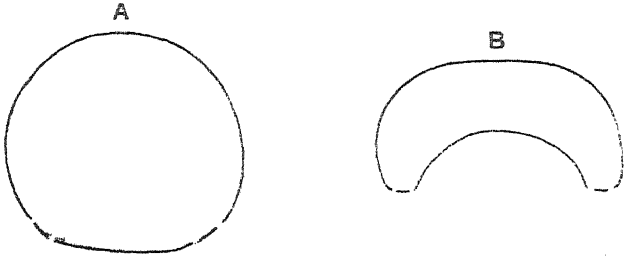
Text-fig. 56.



A ventral scale of *Chrysopelea ornata* Shaw. *a*, *a*, hinge-lines.

the latter by virtue of a pronounced concave surface is buoyed up to a certain extent, and very frequently its fall terminates in a slight upward swoop, so that it reaches the ground with but little violence of impact. The same holds good, as I believe, for those snakes that can convert their cylindrical shape into the semblance of a split bamboo. A specimen of *Chrysopelea ornata* was taken to a height of fifteen to twenty feet and allowed to fall several times; after one or two false starts the snake was felt to glide from the experimenter's hands, straightening itself out and hollowing in the ventral surface as it moved, and it fell not in a direct line to the ground, but at an angle, the body being kept rigid the whole time. The height from which the snake fell was not great enough for it to be possible to determine with any accuracy whether it fell more slowly than when it fell in irregular coils, but it certainly appeared to be so. If the snake was thrown up into the air, it seemed unable to straighten itself out; it had to be launched, so to speak, from the hands in order to induce it to assume the rigid position; and no doubt in its natural haunts the snake prepares itself for a parachute flight by gliding with some force from off a branch, and does not fall in the casual manner of such a species as *Tropidonotus maculatus*.

Text-fig. 57.



Diagrammatic transverse sections of the body of *Chrysopelea ornata*. A, in the normal condition; B, during "flight."

It was not until 1904 that another Dyak collector brought me a specimen of *Dendrophis pictus*, with the assertion that he had witnessed its "flight" from a tree; the story of this quite independent witness was to the effect that he had seen the snake shoot out from a tree and fall at an oblique angle to the ground, its body being held straight during the fall. This species also has the hinged ventral scales characteristic of the genus *Chrysopelea*, but whereas *Chrysopelea* belongs to the Opisthoglyphous group of Colubrines, *Dendrophis* is one of the Aglypha; it is larger than either of the *Chrysopeleæ*. Experiments that were carried out with this species did not prove so conclusive as those with *C. ornata*, but it was observed that if the snake was held up by the tip of the tail the ventral surface of the body became concave by the in-drawing of the ventral scales, and it fell to the ground with the body rigidly held straight. *Dendrophis formosus* Boie and *Dendrelaphis caudolineatus* Gray also have hinged ventral scales, but it has never been reported to me that either of these species "flew," nor, indeed, can I claim to have satisfactorily established the "flight" of *D. pictus*; but it is certainly worthy of note that an independent witness should assert it of a species equipped with the same mechanism for a parachute flight as the two species of *Chrysopelea*.

March 20, 1906.

Dr. Henry Woodward, F.R.S., Vice-President,
in the Chair.

The Secretary read the following report on the additions that had been made to the Society's Menagerie in February 1906:—

The registered additions to the Society's Menagerie during the month of February were 112 in number. Of these 33 were acquired by presentation, 15 by purchase, 48 were received on deposit, and 16 in exchange. The total number of departures during the same period, by death and removals, was 197.

Amongst the additions special attention may be directed to:—

Three Red-handed Tamarins (*Midas rufimanus*) from Surinam, deposited on Feb. 3rd.

A Jaguar (*Felis onca*), ♂, from South America, purchased on Feb. 22nd.

A King Parrot (*Aprosmictus cyanopygius*), ♂, from Australia, presented by Miss Jessie Capes on Feb. 16th.

A Masked Parrakeet (*Pyrrhulopsis personata*) from the Fiji Islands, purchased on Feb. 1st.

A Red-throated Laughing-Thrush (*Ianthocincla rufigularis*) from British India, presented by Mr. R. Phillipps on Feb. 8th. New to the Collection.

The Secretary exhibited a paper cutting representing the print of the fore foot of a very large wild Indian Elephant. The measurement was sixty-six inches in circumference, and had been taken by Mr. C. A. Sherring, Deputy Commissioner at Almora, India. Mr. Sherring believed that the measurement was a "record" and inferred that the Elephant, which was described as enormous and had been seen by several persons, stood 11 feet high at the withers. The Secretary mentioned that in the 'Records of Big Game,' published by Mr. Rowland Ward, one larger measurement had been given, that of a foot-circumference of 67½ inches taken from a living Elephant under charge of Lieut.-Col. G. W. Hanson.

The Secretary also exhibited, on behalf of Mr. John Bowes, F.Z.S., a tooth of the Mammoth from the sand in the estuary of the East Swale, about three miles west of Herne Bay.

Dr. Walter Kidd, F.Z.S., exhibited lantern-slides of sections of the skin from the palmar and plantar surfaces of Mammals. Upwards of 70 species had been examined, and the present series comprised 6 Marsupials, 3 Rodents, 10 Carnivores, and 17 Primates. These groups presented certain common features as regards the papillary ridges and the papillary layers of the corium, which two structures were shown to be closely related in their varieties.

Mr. Oldfield Thomas, F.R.S., F.Z.S., exhibited a skull of a Bear from the Shan States which had been sent to him by Dr. A. Alcock, F.R.S., Superintendent of the India Museum, Calcutta. The Bear had lived for a short time in the possession of the late Mr. Rutledge, a live-animal dealer, who had on its death presented it to the Indian Museum. No Bear had previously been recorded from this part of Asia. The animal proved to be a member of the *Ursus arctos* group, and appeared to be most nearly allied to the *U. a. yesoensis* Lydekker, of Hokkaido, the northern island of Japan, but evidently represented a different form.

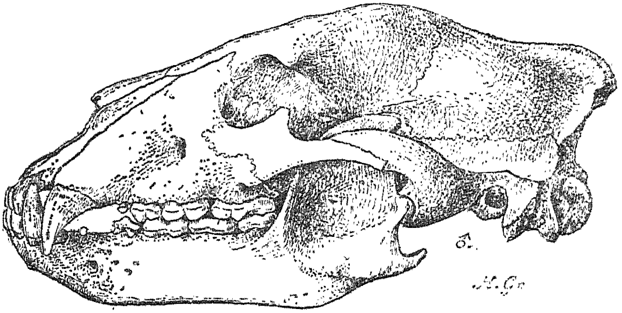
It was proposed to be called

URSUS ARCTOS SHANORUM Thos.

Abstr. P. Z. S. 1906, p. 17 (March 27th).

Size small. General colour dark brown, the hairs of the sides tipped with grey; an ill-defined darker line down the centre of the back.

Text-fig. 58.

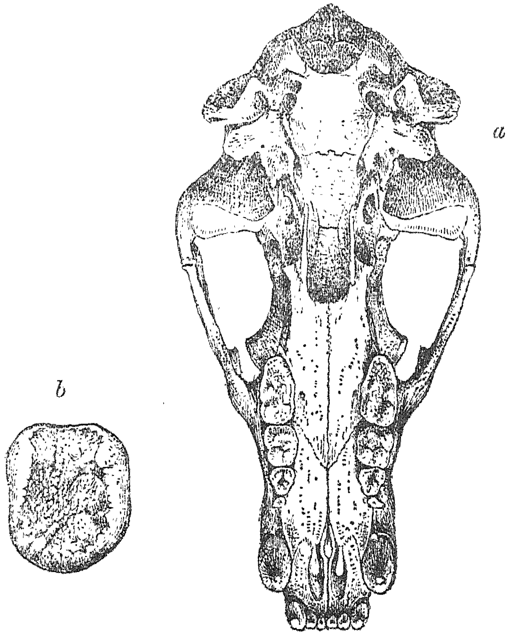


Skull of *Ursus arctos shanorum*, lateral view.

Skull (text-figs. 58, 59 *a*) of the peculiar long, narrow, and vaulted shape of that of *U. a. yesoensis*, but very much smaller than in that animal. Nasals abruptly and strongly narrowing in their posterior half. Breadth across postorbital processes unusually small. Palate narrow. Premaxillæ not extending back to the level of the back of the canines.

Teeth peculiarly short and broad in outline. P^4 very broad and heavy, nearly as broad as long, with low cusps and a low broad internal lobe. M^1 rather shorter, and yet actually broader, than in the type of *yesoensis*. Lower teeth similarly broader throughout, the last molar quite unusually broad and square in shape, not narrowing behind (see text-fig. 59 *b*).

Text-fig. 59.



a, skull, and *b*, last lower molar of *Ursus arctos shanorum*.

Dimensions of the typical skull:—

Basal length 295 mm.; zygomatic breadth 162; length of nasals 82; interorbital breadth 59; breadth across postorbital processes 87; intertemporal breadth 62; breadth of brain-case 95; mastoid breadth 141; palate length 169.

Teeth: p^4 17×15; m^1 22×18; m^2 36×19; p_4 14×7; m_1 23×11·5; m_2 25×16·5; m_3 20×17·5.

Hab. Shan States.

Type. Subadult male. B.M. no. 6.3.16.1.

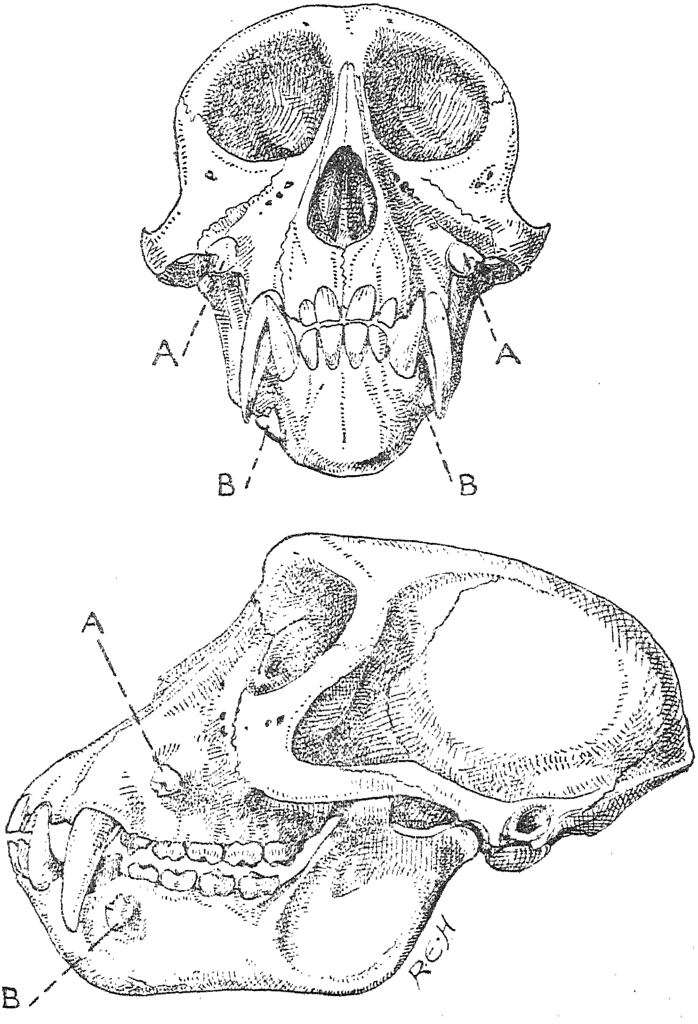
This Bear differed from the Hokkaido Bear, which appeared to be its nearest ally, by its much smaller size and by the marked differences in the shape of the teeth above detailed.

By the kindness of the Trustees of the Indian Museum, the typical specimen of this interesting Bear had been ceded in exchange to the British Museum.

Mr. R. E. Holding exhibited and made remarks upon the following specimens, illustrating anomalies and variations in the teeth of certain animals:—

(1) Skull of a Monkey (*Cercopithecus patas*) (text-fig. 60) showing supernumerary premolars fixed in the body of the maxilla and

Text-fig. 60.



Front and side views of skull of *Cercopithecus patas* bearing supernumerary premolars.

of the lower jaw respectively, an uncommon variation in the eruption of supernumerary teeth.

(2) Portion of the skull of a Rabbit and skull of a Mouse showing curved and elongated incisors, due to the fact that these incisors had never met at their cutting-edges.

(3) Skull of a Borzoi Hound in which the second left premolar had a single fang and the last right permanent molar had a double fang, both conditions being unusual.

(4) Lower incisor teeth of a Cow and of a Horse, showing irregular growth due to injuries to the symphysis or union of the lower jaw.

(5) Skull of a Chacma Baboon (*Cynocephalus porcarius*) showing displacement of the left upper incisors, due to an injury causing necrosis of the premaxilla.

(6) Lower jaw of a Highland Ram showing supernumerary last molars on each side, and lower jaw of a Thar (*Hemitragus jemlaicus*) showing overgrown and elongated molars, due to necrosis in the upper jaw and loss of the corresponding tooth.

The following papers were read:—

1. Note on Deaths occurring in the Society's Gardens during 1905. By C. G. Seligmann, M.B., M.R.C.P.

[Received March 19, 1906.]

In the annexed table will be found the causes of death, so far as they could be discovered, of 296 mammals and 218 birds which died in the Society's Gardens and which were submitted to post-mortem examination during the year 1905. In these mammals and birds no cause of death was found in 28 and 36 instances respectively.

A few words are necessary as to the method of classification adopted in the table. In the first five sections the conditions specified are classified pathologically according to the anatomical nature of the lesion produced. This arrangement is departed from in Section VI., where, under the heading cerebral tumour, are given two cases which logically belong elsewhere, but which are included here, since pressure on the brain produced the symptoms which caused death. In one of these cases the pressure was due to hydatid cysts, in the other to the growth of what was perhaps a Streptothrix. Under parasites are included only those cases in which it appeared that death was directly brought about by pressure and consequent exhaustion due to the presence of the parasite, which in every case given under this heading was an hydatid. Many other animals had parasites of one sort or another which appeared to have exerted little or no pathological influence. The ninth heading includes a number of birds which it appeared probable their companions had killed or severely injured.

	PRIMATES.	CARNIVORA.	RODENTIA.	UNGULATES.	CHIROPTERA.	MARSUPIALIA.	EDENTATA.	BIRDS.
I. *General Diseases.*								
Rickets	11	1	......	......	......	......	......	1
Anæmia	......	......	......	......	......	1	......	1
Gout	......	......	......	......	......	1	......	5
Tuberculosis	53	......	1	6	......	1	......	52
Septicæmia and Pus infections	3	5	......	......	......	......	......	2
II. *Diseases of the Respiratory System.*								
Laryngitis	1	......	......	......	......	......	......	3
Bronchitis	1	......	1	......	......	......	1	2
Broncho-pneumonia	8	7	2	7	......	2		
Pneumonia	21	4	5	8	1	......	1	10
Empyema	......	1						
Mycosis	......	......	......	......	......	......	......	5
III. *Diseases of the Circulatory System.*								
Pericarditis	......	......	......	......	1	......	......	7
Valvular disease of Heart								
Myocarditis	......	3	1	3	......	1	1	4
Arterial disease	......	......	1					
IV. *Diseases of the Digestive Organs.*								
Stomatitis	2	......	......	......	......	5		
Gastritis	......	2						
Gastric Ulcer	2	2	......	......	......	3		
Enteritis	29	7	1	2	......	2	2	11
Colitis and Dysentery	3	2						
Obstruction	......	3	......	......	......	......	......	11
Peritonitis	1	......	......	1	......	......	......	3
Fibrosis of Liver	......	1	......	2				
Cholangitis	......	......	......	1				
Fatty Liver, including 1 case of Jaundice	3	1	1	......	1	......	......	12
V. *Diseases of the Urinary System.*								
Nephritis	......	1	1					
VI. *Diseases of the Nervous System.*								
(A) Brain:								
Meningitis and Congestion	1							
Cerebral Tumour	......	1	......	1				
(B) Cord	1	1						
(C) Peripheral Nerves	......	......	......	1				
VII. *New Growths*	1	1						
VIII. *Deaths due to Parasites*	3	1	......	2	......	1		
IX. *Deaths due to Trauma and Exhaustion*	3	1	1	5	2	1	......	48
X. *Deaths, Various, unclassified*	1	1	......	1	......	......	......	3
TOTAL	148	46	15	40	5	18	5	180

I do not propose to discuss here the deaths from tuberculosis and enteritis among monkeys and birds; the figures given in the appended table are sufficiently striking, and point to the necessity of increased effort to diminish these diseases.

Finally, attention may be directed to the following points of special pathological interest:—

i. The rarity of new growths, of which but two instances occurred, viz., an epithelioma in a Puma, and a columnar-celled adenoma in a Monkey.

ii. The occurrence, in the case of the Sheep with "cerebral tumour" caused by hydatids, of perforation of the vault of the skull, due to intracranial pressure with the absence of optic neuritis of such a degree as to be detected on careful examination of the back of eye with a hand-lens. Attention may also be directed to the absence of any marked limb-weakness in this case until very shortly before death.

iii. The existence in the Gardens of a chronic disease in birds, mycosis, with well-marked post-mortem signs due to invasion of the tissues by a mould, *Aspergillus fumigatus*.

2. A Monograph of the Coleoptera of the Genus *Sciobius* Schh. (Curculionidæ). By Guy A. K. Marshall, F.Z.S.

[Received December 8, 1905.]

(Plates XVIII. & XIX.*)

The genus *Sciobius* was established by Schönherr in 1826 (Disp. Meth. p. 197) for the reception of *Curculio tottus* Sparrm. and *C. pullus* Sparrm.

In 1834 Gyllenhal described two species, *griseus* and *porcatus*, the latter, however, being merely the ♀ of *tottus*. In 1843 Boheman published descriptions of eleven more species, principally from the collections of Drège and of Ecklon & Zeyher; adding yet another in 1845 from Wahlberg's collection. Of the former series, three forms must be regarded as synonyms. In 1862 Wollaston described a single species, *paivanus*, taken by Welwitsch in Angola, but it is doubtful whether the insect has been rightly included in this genus. In 1871 Fåhræus added six more species to the list, all of which had been captured by the distinguished Swedish explorer, Wahlberg.

The present paper contains descriptions of no less than twenty-two additional species, which must provisionally be regarded as new; thus giving a total of forty species exclusive of Wollaston's doubtful insect.

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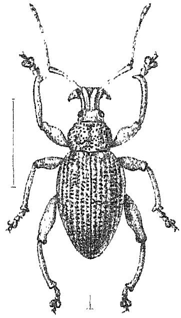
* For explanation of the Plates, see p. 276.

P. Z. S. 1906, vol. I. Pl. XVIII.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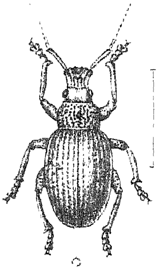
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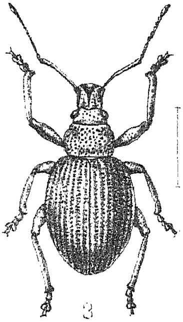
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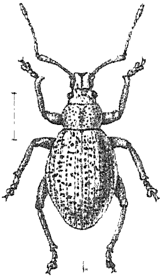
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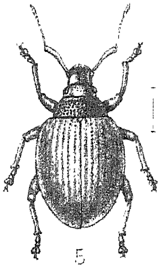
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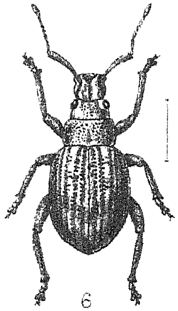
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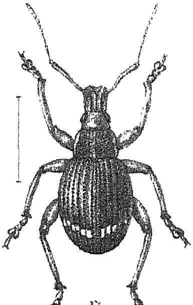
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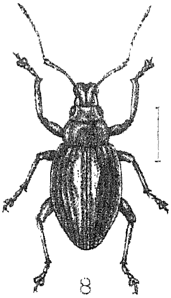
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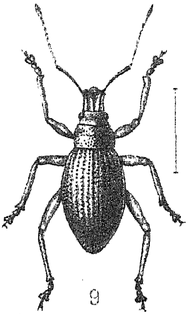
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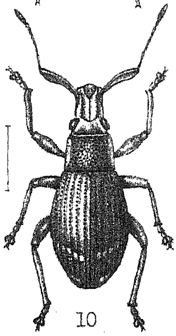
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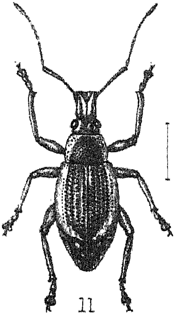
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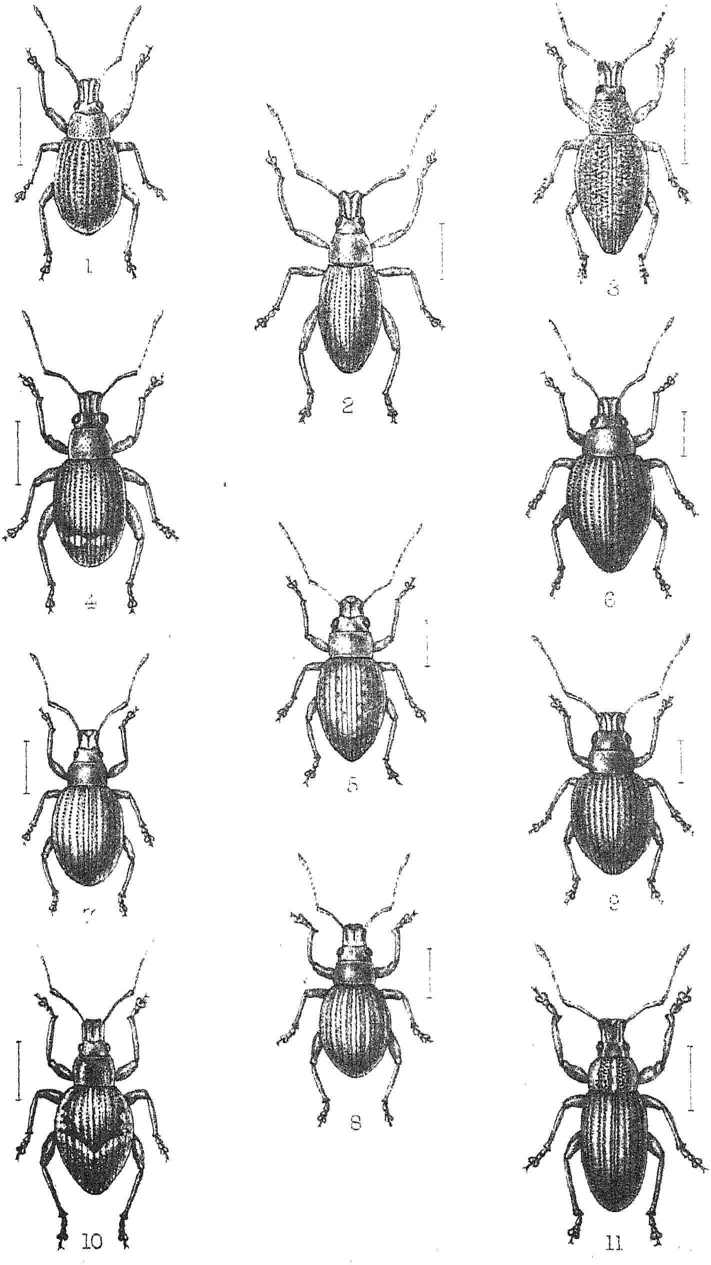
Horace Knight del. et lith.

West, Newman imp.

COLEOPTERA OF THE GENUS SCIOBIUS.



Horace Knight del. et lith.

West, Newman imp.

COLEOPTERA OF THE GENUS SCIOBIUS.

Three other species have been erroneously ascribed to this genus, namely:—

(1) *S. subnodosus* Woll. (Ann. Nat. Hist. (3) ix. 1869, p. 416). The insect was described from St. Helena, and I have examined the types in the Wollaston collection in the British Museum. The species is clearly identical with *Phlyctinus callosus* Boh., which is a common vineyard and garden pest in many parts of Cape Colony, and it is probable that it was accidentally imported thence to St. Helena.

(2) *S. geniculatus* Fst., which has proved to be identical with *Siteutes albicinctus* Fst. (*vide* Stett. ent. Zeit. lviii. p. 70).

(3) *S. mus* Fst. Through the kindness of Dr. Walther Horn, I possess two examples of this species from the Ukami Mts., in German East Africa. They certainly do not belong to the genus *Sciobius*, nor even to Lacordaire's tribe of "Otiorhynchides vrais," owing to the enclosed corbels of their posterior tibiæ. The species is really referable to the tribe Oosomides, and agrees extremely well with both the description and figure of *Sphrigodes margaritaceus* Gerst. (v. d. Decken's Reisen, Glied. p. 226, t. xi. f. 6), with which it is probably synonymous.

From all other genera of the Otiorhynchinæ (except *Calyptops* and *Phlyctinus*) *Sciobius* may be distinguished by the following combination of characters:—the metasternum is very short; the three intermediate segments of the abdomen are subequal in length; the corbels of the posterior tibiæ are entirely open; the tarsal claws are quite free; and the second joint of the funicle is always longer, and usually much longer, than the first.

Phlyctinus Schh., which contains but a single species, *callosus* Boh., may be readily distinguished owing to its having the apex of the rostrum entire (whereas in *Sciobius* it is deeply incised), and also by its very prominent eyes, which are in the form of obtuse cones directed backwards, while their facetting is distinctly coarser than in *Sciobius*. On the other hand, *Calyptops* Schh. is much more closely allied to the latter genus, and indeed the only distinctive character would appear to be the two elevations on the forehead above the eyes. I have not had an opportunity of examining the unique species, *C. granosus* Boh., but judging from the description and from Lacordaire's figure, it evidently presents a great affinity to some of the larger *Sciobii*, which, moreover, in several instances show distinct traces of the supra-ocular elevations. It is therefore not impossible that the genus may have to be incorporated with *Sciobius*.

Certain species of the genus *Systates* Gerst. and *Isaniris* Thom. present a superficial resemblance to some of the more slender *Sciobii*, while *Mitophorus* Gerst. recalls the more rotund species. But all these three genera may be differentiated by their tarsal claws which are connate (at the base only), and by their antennæ, in which the first two joints of the funicle are either equal or the first is longer than the second.

If we exclude *S. paivanus* Woll., the genus *Sciobius* as here defined is restricted to the extra-tropical portions of South-east Africa, including the Transvaal, Zululand, Natal, Orange River Colony and Cape Colony east of about 25° E. Long. The following table will give an idea of the relative distribution of the species as at present known :—

Species.	Cape.	Natal.	Zululand.	Transvaal.	O.R.C.
granosus	......	*	*		
cultratus	... .	*			
cinereus	*				
obesus	......	*	......	*	
dealbatus	......	*			
cognatus	......	*			
opalinus	......	*			
impressicollis	*				
brevicollis	......	*	*	*	
bistrigicollis	......	*			
oneili	*				
granipennis	*				
planipennis	*	*			
lateralis	*				
tenuicornis	......	*	*		
latipennis	*				
aciculatifrons	*	*			
barkeri	.....	*			
scapularis	*				
griseus	*				
pullus	*				
pollinosus	.. ...	*			
marginatus	......	*			
spatulatus	......	*			
péringueyi	......	......	......	*	
viduus	.... .	......	......	*	
pondo	*				
tottus	*	......	......	......	*
muricatus	*				
angustus	......	.. ...	......	*	
panzanus	... ..	*			
schönlandi	*				
viridis	......	... ..	......	*	
nanus	*				
prasinus	......	*			
vittatus	......	......	......	*	
arrowi	......	*			
horni	......	*			
wahlbergi	......	*			
squamulosus	*				
Totals	17	20	3	7	1

The predominance of Natal in point of species is doubtless due to the fact that the Colony has been much better worked, as a whole, than the other areas. When the fauna of the Transkei and Pondoland is better known, it will probably be found that the genus attains its greatest development in Cape Colony. Similarly Zululand and the Transvaal will certainly yield many additional forms. Owing to the large tracts of treeless country in the Orange River Colony the genus is not likely to be well represented there; and although Dr. H. Brauns has kindly sent me a number of Curculionidæ from both Bothaville and Hoopstad, there was not a single *Sciobius* among them.

Of the comparatively few species with whose habits I am acquainted, the majority feed on low trees and shrubs; and on the Natal coast *brevicollis* and *bistrigicollis* are among the commonest beetles to be obtained by general beating. On the other hand, the smallest species, and those with a predominance of bright green colouring, appear to prefer herbaceous plants and are generally obtained with the sweeping-net.

The general type of colouring is black or reddish brown variegated with grey, whitish or yellowish scaling, which has a fairly constant tendency to form a denser lateral stripe, often accompanied by a transverse band across the summit of the elytral declivity. In only a few instances are bright colours to be found, and then they are of a green or golden-green hue. There can be little doubt that in every case the colouring of these insects will be found to have a simple procryptic significance.

There is a well-marked sexual dimorphism in many of the species, so that in one or two cases the sexes have been described as distinct forms. But these sexual characters are often very different in the various species, and the only one which is constant throughout the genus (or, rather, throughout the 24 species of which both sexes are known) is the form of the last abdominal segment. This is always more acuminate in the ♀ and is usually slightly convex in the middle; whereas in the ♂ it is more broadly rounded apically and proportionately more transverse, and generally there is a more or less shallow central impression. Another common character is the greater curvature of the tibiæ, especially the anterior pair, in the ♂. But in the case of *obesus*, *dealbatus*, *opalinus*, *pollinosus*, and *marginatus*, the tibiæ are practically similar in the two sexes. In a few species, such as *brevicollis*, *granosus*, and *pondo*, this distinction is specially well-marked, the tibiæ of the ♂ being also broader and noticeably compressed. In the great majority of instances, however, the difference is comparatively slight. *Horni* presents a special feature in that the anterior tibiæ of the ♂ are distinctly sinuate internally. Another striking sexual character is to be found in the rostrum, in which the genæ of the ♂ are occasionally produced into long, recurved, horn-like processes. But this is only the case with *granosus* and *cultratus*. In *bistrigicollis* and *dealbatus* there is a similar production, only to a much less extent, and the process is not recurved. In *cinereus*, *scapularis*, *griseus*, and *viridis* the genæ are only slightly more dilated in the ♂ than in the ♀; whereas in the remaining 16 species the sexes do not differ in this respect. As a rule, the shape of the prothorax is similar in the two sexes, but in *brevicollis*, *bistrigicollis*, *barkeri*, *marginatus*, *pondo*, and *tottus* this segment is distinctly shorter and more transverse in the ♀; in *granosus* its sides are more strongly rounded in the ♂; while in *cultratus* the central portion is more elevated and smoother in the ♀ than in the ♂. In the majority of species the shape of the elytra varies considerably in relation to sex, but in *cinereus*, *dealbatus*, *cognatus*, *opalinus*, *prasinus*, and *wahlbergi* there is practically no difference; while in *obesus*. *scapularis*, and *horni* the distinction is comparatively slight.

The present revision has only been rendered possible by the generous assistance afforded me by many friends. To the Trustees of the British Museum I am much indebted for their kindly permitting me to bring out to Africa practically the whole of the material contained in the National Collection; and my thanks are particularly due to Mr. G. J. Arrow of that Institution for much valuable assistance, especially in supervising the drawing of the insects and correcting the proofs of this paper. My friend Prof. Dr. Sjöstedt of Stockholm was good enough to lend me typical examples of no less than 19 species described by the old Swedish authors, thus immensely facilitating the labour of identification and ensuring more accurate determination. Dr. D. Sharp of Cambridge, Prof. Poulton of Oxford, Mr. Péringuey of Cape Town, and Dr. Schönland of Grahamstown, all generously placed at my disposal the whole of the examples of this genus which were to be found in the collections of which they are respectively in charge. My fellow-collectors in South Africa, Mr. C. N. Barker and Father O'Neil, have kindly contributed to my needs in their usual open-handed manner; while my good friend Dr. W. Horn of Berlin has most liberally procured for me quite a remarkable number of new and rare species, two of which I have not seen in any other collection.

The following synoptic Table, despite its many shortcomings, will probably render identification somewhat easier.

Specierum Conspectus *.

1. (32.) Prothorax basi utrinque fovea elongata aut rotundata evidenter impressus.

2. (19.) Funiculi articulus tertius primo non, aut vix, longior.

3. (6.) Genæ processu recurvo valde productæ.

4. (5.) Elytra late ovata, humeris rotundatis, prothorax æqualiter granulatus; antennæ breviores, clava ovata. 1. *S. granosus* Fåhr. ♂.

5. (4.) Elytra anguste ovata, humeris valde obliquis; prothorax medio obsolete granulatus; antennæ longiores, clava valde elongata et acuminata .... 2. *S. cultratus*, sp. nov., ♂.

6. (3.) Genæ non recurvo-productæ.

7. (10.) Genæ acute angulariter dilatatæ.

8. (9.) Major (9½–10½ mm.), thorace apice constricto. 3. *S. cinereus*, sp. nov.

9. (8.) Minor (7–8 mm.), thorace apice non constricto. 5. *S. dealbatus* Fåhr.

10. (7.) Genæ rotundatæ aut obtuse angulatæ.

11. (14.) Antennæ longiores, funiculi articuli terminales evidenter longiores quam latiores.

12. (13.) Elytra late ovata, humeris rotundatis, prothorax et elytra undique æqualiter granulata .... 1. *S. granosus* Fåhr. ♀.

13. (12.) Elytra anguste ovata, humeris valde obliquis; prothorax medio parum elevatus ibique obsolete granulatus; elytra retro obsolete granulata .... 2. *S. cultratus*, sp. nov., ♀.

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* It must be noted that two species with which I am acquainted, viz. *S. lateralis* Boh. and *S. muricatus* Boh., are not included in this Key, owing to the fact that several of the diagnostic characters here utilised are not mentioned in Boheman's descriptions.

14. (11.) Antennæ comparate breves et validæ, funiculi articuli terminales non, aut perparum, longiores quam latiores.

15. (16.) Major (10–12 mm.), scapo subcylindrico; interstitiis elytrorum latis, subplanis, omnino lævibus. 4. *S. obesus*, sp. nov.

16. (15.) Minor (5–7 mm.), scapo compresso; interstitiis angustis et convexis, aut tuberculatis.

17. (18.) Fusco-cinereo-squamosus, elytris non tuberculatis, scapo margine anteriore fortiter curvato ...... 6. *S. cognatus*, sp. nov.

18. (17.) Viridi-opalino-squamosus, elytris tuberculis depressis et rotundatis parce adspersis, scapo ante tantum leviter curvato .... 7. *S. opalinus*, sp. nov.

19. (2.) Funiculi articulus tertius primo evidenter longior.

20. (23.) Funiculi articulus tertius quarto evidenter longior.

21. (22.) Prothorax ante fortiter angustatus, lateribus pone medium abrupte angulatis .... 8. *S. impressicollis* Boh.

22. (21.) Prothorax ante nonnihil angustatus, lateribus leviter rotundatis .... 9. *S. brevicollis* Fåhr.

23. (20.) Funiculi articulus tertius quarto non, aut perparum, longior.

24. (25.) Genæ evidenter dilatatæ et angulariter productæ, præcipue in ♂ .... 10. *S. bistrigicollis* Boh.

25. (24.) Genæ non, aut vix, dilatatæ.

26. (29.) Prothorax valde transversus, longitudine duplo latior; minores (4½–6 mm.).

27. (28.) Elytra haud granulata, omnino lævia; prothorax anterius modice augustatus; scapus latus, compressus et ad apicem gradatim dilatatus .... 11. *S. oneili*, sp. nov.

28. (27.) Elytra lateribus granulatis (minus evidenter in ♂); prothorax anterius valde angustatus; scapus angustior, subcompressus, nonnihil abrupte clavatus . 12. *S. granipennis* Boh.

29. (26.) Prothorax modice transversus, dimidio latitudinis longior; majores (7½–10 mm.).

30. (31.) Scapus tenuissimus, non compressus, abrupte clavatus; prothoracis foveæ laterales parvæ, rotundatæ et minus profundæ .... 15. *S. tenuicornis*, sp. nov.

31. (30.) Scapus latus, compressus, gradatim dilatatus; prothorax utrinque profunde et longitudinaliter impressus. 13. *S. planipennis*, sp. nov.

32. (1.) Prothorax ad latera non, aut vix, impressus.

33. (50.) Funiculi articulus tertius primo manifeste longior.

34. (49.) Scapus numquam fusiformis nec supra carinatus.

35. (36.) Elytrorum sutura evidenter elevata, interstitio secundo antice fortiter dilatato et subdepresso... 16. *S. latipennis* Fåhr.

36. (35.) Elytrorum sutura non elevata.

37. (38.) Rostrum a basi ad apicem gradatim angustatum; elytrorum interstitium secundum versus basin dilatatum et stria secunda sinuata (præcipue in ♀); frons subtiliter aciculata.................................... 18. *S. barkeri*, sp. nov.

38. (37.) Rostrum parallelum aut apice leviter dilatatum; stria secunda versus basin non sinuata, aut aliter cum fronte evidenter striolata.

39. (48.) Elytra basi haud constricta, angulis externis non tuberculato-productis.

40. (45.) Scapus latus, evidenter compressus et versus apicem fere parallelus.

41. (44.) Elytra ovata, ante medium latiora, apice subacuminata.

42. (43.) Prothorax ad latera utrinque leviter subdepressus, ibique pallido-squamosus, in dorso granulis depressis adspersus, lateribus leviter rotundatis nec subangulatis. 19. *S. scapularis* Boh.

43. (42.) Prothorax ad latera haud depressus, in dorso coriaceus nec granulatus, lateribus prope basin subangulatis. 17. *S. aciculatifrons* Boh.

44. (41.) Elytra globosa aut subglobosa, in medio latiora, apice late rotundata..................................... 20. *S. griseus* Gyl.

45. (40.) Scapus angustior, non, aut vix, compressus, apice evidenter clavatus.

46. (47.) Elytra latissime ovata, retrorsum late rotundata; tarsorum articulus primus tertio evidenter angustior, secundo et tertio simul sumptis brevior.............. 21. *S. pullus* Sparrm.
47. (46.) Elytra anguste ovata, retrorsum subacuminata; tarsorum articulus primus tertio haud angustior, secundo et tertio simul sumptis longitudine æqualis ...... 22. *S. pollinosus* Fåhr.
48. (39.) Elytra basi constricta, angulis externis plus minusve tuberculato-productis........................ 23. *S. marginatus* Fåhr.
49. (34.) Scapus latissimus, fusiformis, supra medio evidenter carinatus .... 24. *S. spatulatus*, sp. nov.
50. (33.) Funiculi articulus tertius primo non, aut vix, longior.
51. (78.) Oculi laterales, distantes, prominuli aut saltem evidenter convexi.
52. (75.) Prothorax medio non canaliculatus, interstitia elytrorum æque elevata.
53. (72.) Tibiæ posteriores interne haud crenulatæ.
54. (67.) Corpus non metallico-viridi-squamosum.
55. (58.) Elytra fascia pallida transversa pone medium ornata.
56. (57.) Elytra retro subacuminata, ad latera pallide sulphureo-squamosa, basi prothorace paullo latiora, angulis externis leviter prominulis et subrectangulis ... 25. *S. péringueyi*, sp. nov.
57. (56.) Elytra retro late rotundata, undique cinereo-squamosa, basi prothorace vix latiora, humeris rotundatis. 31. *S. panzanus*, sp. nov.
58. (55.) Elytra numquam transversim fasciata.
59. (60.) Elytra pone medium latiora, apice late rotundata, si superne inspecta .... 26. *S. viduus*, sp. nov.
60. (59.) Elytra ante medium aut in medio ipso latiora, apice subacuminata.
61. (64.) Elytrorum interstitia granulata.
62. (63.) Funiculi articulus tertius quarto manifeste longior, elytra setis pallidis longis suberectis adspersa; major (11–12 mm.). 27. *S. pondo*, sp. nov.
63. (62.) Funiculi articulus tertius quarto non longior, elytra setulis minutis depressis, retrorsum tantummodo perspiciendis, adspersa; minor (8–10 mm.) .... 28. *S. tottus* Sparrm.
64. (61.) Elytrorum interstitia haud granulata, omnino lævia.
65. (66.) Elytra elongata et angustata, dense olivaceo-cinereo-squamulosa, baseos angulis externis prominulis et subrectangulis. 30. *S. angustus*, sp. nov.
66. (65.) Elytra late ovata, omnino denudata, humeris rotundatis. 32. *S. schönlandi*, sp. nov.
67. (54.) Corpus æqualiter metallico-viridi- aut aureo-viridi-squamosum.
68. (69.) Genæ angulatæ et productæ.................. 33. *S. viridis*, sp. nov.
69. (68.) Genæ haud productæ.
70. (71.) Rostri carinæ exteriores evidentes; elytra breviora, lata, obtuse ovata; prothorax longitudine duplo latior. 34. *S. nanus*, sp. nov.
71. (70) Rostri carinæ exteriores obsolescentes; elytra longiora, apice subacuminata; prothorax dimidio latitudinis longior. 35. *S. prasinus*, sp. nov.
72. (53.) Tibiæ posteriores interne evidenter crenulatæ.
73. (74.) Elytra convexa, ante medium altiora (a latere inspecta), interstitiis alternis cinereo- et brunneo-squamosis, dorso haud setulosis .... 36. *S. vittatus*, sp. nov.
74. (73.) Elytra dorso antice deplanata, longe pone medium altiora, brunneo-squamulosa et fascia communi pallida angulata pone medium ornata, dorso setulis brevibus erectis parce adspersa .. .. 37. *S. arrowi*, sp. nov.
75. (52.) Prothorax evidenter sed minus profunde canaliculatus; elytra interstitiis aliquis altioribus, saltem prope basin.
76. (77.) Funiculi articulus primus tertio non longior; elytrorum interstitia alterna altiora (minus evidenter in ♀) sed haud carinata .... 38. *S. horni*, sp. nov.
77. (76.) Funiculi articulus primus tertio multo longior; interstitia 2, 3, 4 et 7 carinata, 5 et 8 tantum prope basin, 6 tantum prope apicem, carinata .... 39. *S. wahlbergi* Boh.
78. (51.) Oculi fortiter depressi, magis approximati et subdorsales. 40. *S. squamulosus* Boh.

1. Sciobius granosus Fåhr.

S. granosus Fåhr. Œfv. K. Vet.-Ak. Förh. 1871, p. 27.

Long. 10–13, lat. 5–6½ mm.

Head twice as broad as its length, with scattered punctuation and sparse yellow scaling; forehead with an ill-defined central impression and a slight tubercular elevation above the eyes, which are very prominent. *Rostrum* longer than broad, as long as prothorax, tricarinate dorsally, and with a short lateral carina just in front of eye; genæ produced in ♂ into a long (1⅕ mm.) recurved horn-like process, rounded and only slightly prominent in ♀; upper surface with irregular shallow punctuation and dense ochreous scaling. *Antennæ* moderately long, piceous, irregularly aciculate and with fine pale pubescence; scape compressed and gently curved, third joint of funicle scarcely longer than first. *Prothorax* very transverse, sides strongly rounded, especially in the ♂, broadest about middle, base truncate, apex narrower and slightly sinuate, with a faint constriction and an impressed transverse line close to the margin; upper surface convex, but flattened in the median basal area and fairly closely covered with smooth depressed tubercles; the interstices are thinly clothed with ochreous scales, and there is a short curved lateral impression on each side near the base. *Elytra* broadly ovate, shoulders obliquely rounded, sides ampliated, broadest near base; upper surface convex in ♀, subdepressed in ♂, with shallow striæ containing rows of distinct separated granules; the intervals with rows of low rounded tubercles, which are absent on the inflexed margins, the striæ there being also simply punctate; colour black or piceous brown, granules and tubercles bare and shiny, the interstices with thin yellowish scaling. *Legs* stout, thicker in the ♂, black or piceous brown, finely aciculate and sparsely punctured, with yellowish scales and setæ which are dense near the apex of femora; the anterior pairs of tibiæ broader and more strongly curved in the ♂.

Types ♂ ♀ in the Stockholm Museum.

Natal: Upper Tongaat R. (*C. N. Barker*), Estcourt (*G. A. K. M.*), Durban (*A. D. Millar*), Maritzburg [S.A. Mus.]. Zululand: Eshowe [S.A. Mus.].

It is evident from his description that Fåhræus took the ♂ of this species for the ♀, both sexes being represented in Wahlberg's series. It is curious that he makes no reference to the striking horn-like rostral processes of the ♂, which distinguish it from all other species of the genus except *S. cultratus*.

2. Sciobius cultratus, sp. nov. (Plate XVIII. fig. 1.)

Long. 8⅖–10½, lat. 4½–5⅖ mm.

Head strongly transverse, finely aciculate and with rather thin grey scaling; forehead finely plicate, with no distinct impressions; eyes prominent. *Rostrum* distinctly longer than its width at base; in the ♂ the sides are somewhat narrowed from the base to about middle, and the genæ are produced into broad but sharp sickle-shaped processes; in the ♀ the sides are subparallel basally and the genæ are only moderately and roundly dilated; upper surface impressed, tricarinate, the outer carinæ parallel from base to beyond middle, thence widely diverging, an additional short curved carina in front of eyes; punctuation and scaling as on the head, the central carina bare. *Antennæ* comparatively long and slender, piceous, with fine grey pubescence; scape clavate, slightly compressed and distinctly curved; first joint of funicle about as long as third, the subterminal joints elongate. *Prothorax* moderately transverse, base gently bisinuate, sides not much rounded, broadest before middle, with a shallow constriction near apex, which is truncate and narrower than the base; upper surface convex, with scattered rounded granules, except along a broad central space which is almost smooth, punctured and slightly elevated, being more prominent in the ♀ than in the ♂; a rounded impression on each side near base; colour piceous, the granules and the central ridge (in the ♀) bare, the interstices with grey scaling. *Elytra* subtruncate at base, ovate, more acuminate apically in the ♂, so that the sides appear more rounded than in the ♀, broadest well before middle; upper surface convex, with broad striæ containing shallow rugose punctuation, the intervals convex, more or less distinctly granulate, often subrugose; colour piceous, with uniform grey scaling, the intervals posteriorly with rows of small grey squamiform setæ. *Legs* piceous or ferrugineous, with the knees black, and with fine grey scaling; all the femora more strongly clavate in the ♂ than in the ♀, and the tibiæ more strongly curved, especially the anterior pairs.

TYPE, ♂ in the British Museum, ♀ in the Oxford Museum.

NATAL: Durban (*H. W. Bell-Marley*), Pinetown [coll. G. A. K. M.], Maritzburg [S.A. Mus.], Howick (*C. N. Barker*).

Allied to *granosus* Fåhr., but with much narrower elytra, the obliquity of the shoulders being most noticeable in the ♂; the sides of the prothorax are also much less strongly rounded and the lateral impressions deeper; in perfect specimens there is a small round whitish spot at the base of each elytron.

3. SCIOBIUS CINEREUS, sp. nov. (Plate XVIII. fig. 3.)

Long. $9\frac{2}{3}$–$10\frac{1}{2}$, lat. 5–6 mm.

Head transverse, with coarse shallow punctuation which is hidden by dense grey scaling; forehead with a central impression and with a slightly raised fold above the eyes, which are prominent. *Rostrum* rather longer than broad, sides parallel to beyond middle; genæ sharply and laterally produced in both sexes, but more prominent in the ♂; upper surface shallowly impressed, tricarinate, the outer carinæ with a strong outward curve towards apex; punctuation rugose, but the whole surface covered with dense scaling except the central carina. *Antennæ* moderately long and thick, piceous, with dense grey pubescence; scape subcylindrical, evenly curved and gradually clavate; funicle with the first joint equal to the third, the subterminal joints comparatively short, subconical. *Prothorax* strongly transverse, subtruncate at base, evidently narrower and truncate at the apex, sides not much rounded, broadest rather before middle and distinctly constricted close to apex; upper surface convex, set with rather distant small rounded granules, with a deep rounded lateral impression on each side near the base and a transverse impressed line at the apical constriction; colour piceous, the granules bare, the interstices with dense even grey scaling. *Elytra* broadly ovate, of the same shape in the two sexes, subtruncate at base, sides rounded, broadest about middle; upper surface convex, the striæ containing rows of large shallow punctures separated by small granules and more or less hidden by the scaling, disappearing behind middle, where the striæ become deeper; the intervals rather narrow, subequal in width, convex (more so posteriorly), uneven owing to the presence of depressed obsolescent granules; colour piceous, covered with uniform grey scaling. *Legs* stout, piceous, with rather thin pale scaling, the anterior tibiæ not curved, but the internal apical angle more produced in the ♂ than in the ♀.

TYPE, ♂ in the British Museum, ♀ in the Oxford Museum.

CAPE COLONY: Knysna (*W. F. Purcell*). TRANSKEI: Kentani (*Rev. Dr. F. C. Kolbe*).

I am indebted to Dr. Walther Horn for six examples of this species, but they are without exact locality, being merely labelled "Cape."

This insect is very closely allied to *S. cultratus* Mshl., of which it is probably the Cape Colony representative. It is, however, a larger and more robust insect and the elytra of the ♂ are not acuminate posteriorly; the dilated genæ are not recurved in the ♂, they are sharp and not rounded in the ♀; the antennæ are a little shorter and thicker; the prothorax is much more transverse and entirely lacks the smooth raised central portion of *cultratus*; the apical abdominal segment is much broader and less acuminate in both sexes; finally, in *cultratus* the anterior tibiæ of the ♂ are distinctly curved on their outer edge and the internal apical angle is sharp in both sexes, whereas in *cinereus* the outer edge of the anterior tibiæ is straight and the internal angle is broadly and bluntly produced in both sexes.

4. SCIOBIUS OBESUS, sp. nov. (Plate XVIII. fig. 2.)

Long. 10⅗–12, lat. 5⅗–6⅘ mm.

Head strongly transverse, its length rather less than half the breadth, black, finely aciculate and densely covered with grey or yellowish scaling with a metallic golden reflection; forehead with a deep longitudinal impression in the middle and a shallow one on each side of it; a distinct rounded projection above the eyes, which are prominent. *Rostrum* a little longer than the width at base; genæ moderately dilated into a blunt angle, similar in the two sexes; upper surface deeply excavate, with a smooth central carina, the lateral carinæ bisinuate in the (unique) ♂, straight and convergent basally in the ♀, beyond these an additional short broad basal carina; punctuation and scaling as on the head, only the central carina bare of scales. *Antennæ* moderately long and stout, densely covered with golden yellow or grey scaling; scape only slightly curved, subcylindrical, very gradually thickened from base to apex; first joint of funicle rather longer than third, the three subterminal joints as broad as long. *Prothorax* with its width $1\frac{1}{2}$ times its length, base truncate, the sides gradually dilated from there to far beyond middle, suddenly constricted near apex, which is also truncate and only a little narrower than the base; upper surface convex, moderately closely set with small rounded tubercles and with a rounded lateral impression at base; the central carina variable, complete and distinct in some specimens, abbreviated and irregular in others: colour black, the central carina and apices of the tubercles bare, the rest with dense grey or golden-yellow scaling. *Elytra* broadly ovate (a little narrower in the ♂), jointly sinuate at base, shoulders obliquely rounded, sides strongly ampliated, broadest before middle; upper surface convex, with shallow striæ containing rows of large shallow closely-set punctures, which are much reduced towards apex and which are partially hidden throughout by the scaling; the intervals broad and smooth, very slightly convex, finely aciculate and without tubercles or granules of any kind; colour black with dense grey or yellowish scaling, usually with a dull metallic reflection, the paler scales being silvery and the darker golden. *Legs* comparatively short and stout, with yellowish or grey scaling and short pale setæ; all the tibiæ moderately curved and similar in the two sexes.

TYPE, ♂ in the British Museum, ♀ in the Oxford Museum.

NATAL: Colenso [Oxf. Mus.], Frere (*G.A.K.M.*). TRANSVAAL: Leydenburg [Brit. Mus. & Transv. Mus.].

From the three preceding species, which it resembles in size and facies, *obesus* may be distinguished by its broad and perfectly smooth elytral intervals, as well as by the more or less complete central carina on the prothorax.

5. SCIOBIUS DEALBATUS Fähr.

S. dealbatus Fähr. op. cit. p. 28.

Long. 7–8, lat. $3\frac{2}{5}$–$4\frac{2}{5}$ mm.

Head strongly transverse, coriaceous, finely plicate on forehead, densely covered with white scaling; eyes moderately prominent. *Rostrum* short, subquadrate, the length equal to the width at base, as long as the prothorax; the genæ produced into a short but acute projection, which is rather longer and sharper in the ♂; upper surface subdepressed, tricarinate, the central carina more distinct than the others, bare, impunctate, the remainder of the rostrum covered with dense white scaling. *Antennæ* moderately long, piceous, with dense white setæ; scape subcylindrical and gently curved, third joint of funicle as long as first. *Prothorax* very transverse, its length equal to half the width at base, which is slightly bisinuate, apex a little narrower and truncate, sides moderately rounded, broadest about middle; upper surface convex, dispersely granulate and with a rounded lateral impression on each side of the base, the apices of the granules bare, the interstices filled with dense white or yellowish scaling. *Elytra* ovate, scarcely differing in shape in the two sexes, shoulders very oblique, sides evenly rounded, broadest about middle; upper surface convex, with shallow striæ containing rows of large shallow separated punctures; the intervals slightly convex, smooth and finely aciculate, the third rather broader than the others; colour black or dark brown, with white or yellowish scaling, which is denser apically and throughout the third interval, but the scales vary considerably in density in different individuals; on the apical half the intervals have rows of very short depressed white setæ. *Legs* piceous, evenly covered with moderately dense white scaling and setæ; in shape and thickness they scarcely differ in the two sexes.

TYPE ♂ in the Stockholm Museum.

NATAL: Durban (*C. N. Barker*, *A. D. Millar*, & *H. W. Bell-Marley*).

Varies a good deal in coloration, some examples having the elytra with alternate stripes of lighter and darker scaling. In the type the scaling is uniform in colour, dense and even throughout the sides and declivity, but somewhat abraded on the disk except for the usual denser stripe on the third interval.

6. SCIOBIUS COGNATUS, sp. nov. (Plate XVIII. fig. 6.)

Long. $5\frac{3}{5}$–$6\frac{3}{5}$, lat. 3–$3\frac{3}{5}$ mm.

Head strongly transverse, coriaceous; the forehead finely plicate, covered with dense grey scaling, and with a slightly raised fold above the eyes, which are prominent. *Rostrum* subquadrate, the length equal to the width at base; genæ moderately and roundly dilated, similar in the two sexes; upper surface broadly excavate, evidently tricarinate, the outer carinæ distinctly sinuate, the whole surface except the central carina densely covered with grey scaling. *Antennæ* rather short and thick, covered with grey scaling, scape broad curved and compressed, strigoso-punctate; first joint of funicle broader than the rest, a little longer than the third. *Prothorax* nearly twice as broad as long, base slightly bisinuate, apex a little narrower and truncate, sides moderately rounded, broadest about middle; upper surface convex, dispersely granulate and with a rounded lateral impression on each side of the base, the apices of the granules mostly bare, the interstices filled with dense greyish scaling. *Elytra* broadly ovate, jointly sinuate at base, shoulders obliquely rounded, sides moderately ampliated, broadest about middle, similar in the two sexes; upper surface convex, with shallow striæ containing rows of large deep punctures (partially concealed by the scaling); the intervals rather narrow, smooth and finely aciculate, the third not broader than the others; colour black or dark piceous, covered with dense dull grey scaling, variegated with paler scales which usually form a broad but faint chevron-shaped marking behind middle, the intervals with rows of minute depressed white setæ which are more noticeable posteriorly. *Legs* short and stout, piceous and uniformly covered with greyish scaling; the anterior tibiæ are slightly more curved at the apex in the ♂, but otherwise the legs are similar in the two sexes.

NATAL: Umvoti (*H. Fry*), Estcourt and Drakensberg (*G. A. K. M.*).

TYPE, ♀ in the British Museum, ♂ in the Oxford Museum.

Closely allied to *dealbatus* Fåhr., which it evidently replaces in the upland districts of Natal. From that species it may be distinguished by the broader scape, the rounded genæ, the narrower elytral intervals, the more deeply punctured striæ, and the less oblique shoulders.

7. SCIOBIUS OPALINUS, sp. nov. (Plate XVIII. fig. 4.)

Long. $5\frac{2}{5}$–6, lat. $2\frac{4}{5}$–$3\frac{1}{5}$ mm.

Head strongly transverse, coriaceous and covered with dense opalescent white scaling; forehead with three shallow impressions and a slightly raised fold above the eyes, which are prominent. *Rostrum* subquadrate, a little longer than broad, genæ moderately and roundly dilated in both sexes; upper surface almost plane, tricarinate, with punctuation and scaling as on the head, the central carina only bare and smooth, the outer carinæ straight and parallel. *Antennæ* comparatively short and thick, black with fine pale scaling; the scape curved and compressed, strigoso-punctate, first joint of the funicle broader than the rest, a little longer than the third. *Prothorax* nearly twice as broad as long, base slightly bisinuate, apex a little narrower and truncate, sides moderately rounded, broadest about middle; upper surface convex, dispersely granulate, and with a rounded impression on each side near the base, a few of the granules with their apices bare, the interstices filled with dense opalescent white scaling. *Elytra* ovate, slightly sinuate at the base, shoulders very oblique, sides moderately rounded, broadest about middle, the shape similar in the two sexes; upper surface convex, with faint striæ containing very shallow punctures. When the scaling is removed these punctures are seen to be uneven and irregular and entirely disappear behind middle; in unabraded examples the punctures appear to be small and regular and the intervals broad and smooth, with a few very scattered low rounded tubercles and with widely separated minute white setæ, but without the scaling the intervals appear narrower and less regular and a few more tubercles are observable, but these are variable in number and disposition. *Legs* black or piceous, with uniform pale scaling, moderately short and stout and similar in the two sexes.

NATAL: Malvern (*C. N. Barker*), Howick (*Dr. F. D. Brown*).

TYPE, ♀ in the British Museum, ♂ in the Oxford Museum.

Allied to *dealbatus* Fåhr. and *cognatus* Mshl., from both of which it differs in its smaller size and very different coloration.

From the former it also differs in its broader scape, rounded genæ, the irregular punctuation of the elytra, and the tuberculation of the intervals. The two latter characters also distinguish it from *cognatus*, as well as the parallel outer carinæ of the rostrum, the more oblique shoulders, the less convex intervals of the elytra, the wide separation of the minute white setæ on the intervals, and the less compressed and less curved scape.

*8. SCIOBIUS IMPRESSICOLLIS Boh.

S. impressicollis Boh. Schönh. Gen. Curc. vii. 1, p. 199 (1843).

Long. $6\frac{4}{5}$–$7\frac{3}{5}$, lat. $3\frac{4}{5}$–$4\frac{1}{5}$ mm.

Head transverse, almost plane, finely plicate; forehead not impressed; eyes not prominent. *Rostrum* about as long as broad, subtruncate at base, rather narrowed anteriorly, genæ not dilated; upper surface plane, strigosely punctate, distinctly tricarinate, the outer carinæ straight and parallel. *Antennæ* moderate, piceous, with sparse grey scaling; scape compressed, strigoso-punctate, strongly bisinuate and gradually thickened to apex; funicle with the third joint much longer than first. *Prothorax* very transverse, base slightly arcuate, apex much narrower and truncate; sides parallel for a short distance from base, then rapidly narrowed to apex, thus forming a very distinct obtuse angulation; upper surface slightly convex, closely set with very depressed subconfluent granules and with a deep impressed line on each side of the base; colour black, with sparse grey scaling which is denser laterally. *Elytra* broadly ovate, jointly sinuate at base, sides moderately rounded, broadest about middle; upper surface convex, with distinct striæ containing shallow punctures separated by small granules which become obsolete behind middle; the intervals slightly convex, of equal width, transversely rugose, smoother on the declivity, but with traces of small granules; colour black, with thin grey scaling, which is denser laterally. *Legs* moderate, piceous, with fine grey scaling; anterior tibiæ very slight, curved externally.

TYPE ♀ in the Stockholm Museum.

"CAPE OF GOOD HOPE (*Drège*)."

This description has been made from the type, which is the only specimen I have seen. The strong angulation of the sides of the prothorax is a very distinctive character; apart from this the species much resembles *brevicollis* Fâhr. ♀.

9. SCIOBIUS BREVICOLLIS Fâhr.

S. brevicollis Fâhr. op. cit. p. 29.

Long. ♂ 5–6, ♀ $5\frac{1}{5}$–$6\frac{2}{5}$; lat. ♂ $2\frac{3}{5}$–$3\frac{1}{5}$, ♀ $3\frac{1}{5}$–4 mm.

Head transverse, aciculate, with fine grey or yellowish scaling which is denser laterally; forehead with a shallow central impression; eyes not prominent. *Rostrum* longer than broad, obtusely angulate at base, sides somewhat sinuate; genæ rounded, scarcely dilated in either sex; upper surface more or less impressed, finely tricarinate, the central carina sometimes obsolescent, the outer ones straight and parallel. *Antennæ* long and slender, piceous, with fine grey scaling; the scape compressed, strongly bisinuate, gradually dilated to apex; funicle with the third joint distinctly longer than first, the subterminal ones elongate and clavate. *Prothorax* twice as broad as long in the ♂, more than twice as broad in the ♀, base subangulate, apex narrower and sinuate (more markedly so in the ♂), sides slightly rounded, broadest at base; upper surface slightly convex, closely set with low rounded granules, with a smooth subdepressed central line and a distinct curved impression on each side; colour black, granules bare, the interstices with fine grey or yellowish scaling, which is sparse on the disk, except in the three impressed lines, and very dense on the underparts. *Elytra* narrowly ovate in the ♂, broadly ovate in the ♀, jointly emarginate at base, the humeral angle more or less acutely prominent in ♂, obtuse in ♀; sides almost parallel from base to beyond middle in ♂, strongly rounded and broadest about middle in ♀; upper surface depressed in ♂, convex in ♀, with broad striæ containing rows of shallow punctures separated by small granules; the intervals convex, with irregular obsolescent granules, which are distinct and prominent only on the apical declivity, the second interval broader than the third near the base in the ♀ only; colour black, with grey or yellowish scaling, which is sparse dorsally, but forms a dense irregular band along the inflexed margins and across the summit of the declivity; on the disk there are some stripes of denser scaling in the ♂. *Legs* long and thick in ♂, short and comparatively slender in ♀, piceous, with even fine grey scaling; in the ♂ the posterior pairs of tibiæ are slightly curved, the anterior pair very strongly so, the posterior femora reach, when fully extended, just beyond the elytra; in the ♀ the anterior tibiæ are only slightly curved and the posterior pairs straight, the posterior femora do not reach the apex of the elytra.

TYPE ♂ in the Stockholm Museum.

NATAL: Durban (*J. P. Cregoe* & *A. D. Millar*), Malvern (*C. N. Barker* & *G. A. K. M.*), Upper Tongaat R. (*C. N. Barker*), Lower Tugela R. (*E. D. Reynolds*). ZULULAND: Lower Tugela R. (*E. D. Reynolds*), Eshowe (*A. Windham*). TRANSVAAL: Potchefstroom (*T. Ayres*).

In the British Museum there is a series of 8 males and 3 females from the Lower Tugela, which represent a fairly well-marked varietal form. The difference is more marked in the ♂, in which the elytra are distinctly broader in proportion to their length, the sides being gently rounded instead of subparallel; the humeral angle is therefore more obtuse and the intervals appear to be a little broader. The markings on the elytra are pure white, there being a sharply defined stripe on the second interval which unites near the base with a quadrate scutellar patch. The ♀ differs only in shape from the type form, two of the specimens having the elytra much shorter and more rotund; the third example, however, appears to be normal. These distinctions cannot be regarded as of specific value, for in the long series which I have been able to examine I find a certain proportion of intermediate forms, which render it impossible to separate specifically the two extremes.

On one of my females of this species there is a note which I made in Stockholm, to the effect that this was the form which Boheman regarded as the ♀ of his *bistrigicollis*. In this he was certainly in error, as I have taken the latter species *in copulâ*. In the present species the sexes have not been thus definitely ascertained, but, despite its striking difference, I can have but little doubt that the ♀ here described is that of *brevicollis*.

This insect has a much wider range than any other in the genus. The Transvaal record is based on a single ♀ in the South African Museum. In the British Museum there is a specimen labelled "Angola," but the locality seems doubtful.

10. Sciobius bistrigicollis Boh.

S. bistrigicollis Boh. op. cit. vii. 1, p. 202 (1843).

Long. ♂ 4–5$\frac{3}{5}$, ♀ 5$\frac{1}{5}$–6$\frac{2}{5}$; lat. ♂ 2$\frac{1}{5}$–3, ♀ 3–3$\frac{4}{5}$ mm.

Head very transverse, coriaceous, with thin pale setiform scaling; forehead with a shallow central impression; eyes rather prominent. *Rostrum* longer than broad, arcuate or subangulate at base, sides sinuate, genæ angularly produced in both sexes, but much longer and sharper in the ♂; upper surface plane, bicarinate, the carinæ gently sinuate, the central carina absent or obsolescent, scaling and punctuation as on the head. *Antennæ* long and moderately slender, piceous, with fine grey pubescence; scape subcompressed, strongly curved, gradually clavate, funicle with third joint longer than first, subterminal joints elongate. *Prothorax* rather broader than long in the ♂, more transverse in the ♀, the base arcuate, apex narrower and truncate, broadest at base, the sides rounded near apex in the ♂, sublinear and more oblique in the ♀; upper surface slightly convex, evenly set with small rounded granules, with a distinct curved lateral impression and occasionally with a faint central impressed line; colour piceous, granules bare, the interstices with fine grey or yellowish pubescence, which is denser along the median line, and there is a broad lateral band of dense whitish scales. *Elytra* ovate in the ♂, much broader and pyriform in the ♀, jointly emarginate at base, the sides moderately rounded and broadest about middle in the ♂, but strongly rounded and broadest much behind middle in the ♀; upper surface convex in the ♀, subdepressed in the ♂, with distinct striæ containing rows of punctures separated by granules (in the ♀ the fifth stria is usually deeper than the others); the intervals slightly convex, smooth and impunctate anteriorly, but more or less strongly granulate on the declivity; colour piceous, with fine grey depressed pubescence and patches of dense white or yellowish scaling disposed as follows: a small, quadrate patch round the scutellum, a broad, very irregular band along the inflexed margins, a narrower, broken, transverse band across the summit of the declivity, and some irregular mottling on the declivity itself; these markings are usually better defined in the ♂. *Legs* moderately long and stout, piceous or ferruginous, with fine pale pubescence, anterior tibiæ slightly curved in the ♂, less curved in the ♀.

TYPE in the Stockholm Museum.

NATAL: Malvern (*C. N. Barker* & *G. A. K. M.*), Umkomaas R. (*G. A. K. M.*), Durban (*J. P. Cregoe*), Umbilo (*H. W. Bell-Marley*).

The ♂ may be readily distinguished from all its smaller allies by its very prominent genæ. The ♀ is not unlike that of *brevicollis*, from which it may be recognised by its more prominent genæ, much less transverse thorax, and subpyriform elytra.

11. SCIOBIUS ONEILI, sp. nov. (Plate XVIII. fig. 5.)

Long. $4\frac{1}{5}$–$5\frac{1}{2}$, lat. 3–$3\frac{2}{5}$ mm.

Head transverse, slightly convex, almost bare and with numerous fine longitudinal striæ; forehead not impressed; eyes not prominent. *Rostrum* about as long as broad, arcuate at base, slightly narrowed anteriorly, genæ not dilated; upper surface plane, distinctly striolate and with three narrow carinæ, the outer ones quite straight and parallel. *Antennæ* rather short, piceous, with fine grey scaling; scape broad, compressed, strongly curved and gradually dilated to apex; funicle with third joint longer than first, terminal joints elongate and subconical. *Prothorax* strongly transverse, $2\frac{1}{2}$ times as broad as long, arcuate at base, apex narrower and truncate, sides slightly rounded, broadest near base; upper surface convex, closely and evenly set with depressed rounded granules, with a deep longitudinal impression on each side of the base; colour black, with very thin fine grey scaling, which is a little more dense underneath. *Elytra* very broadly ovate, jointly sinuate at base, obtusely rounded at apex, sides strongly rounded, broadest before middle; upper surface convex, distinctly punctato-striate, the punctures continued to apex, the intervals of equal width, almost plane, quite smooth and finely alutaceous; colour black, with uniform thin grey scaling. *Legs* moderate, black, with fine grey scaling, the anterior tibiæ straight.

TYPE ♀ in the British Museum.

CAPE COLONY: Grahamstown ("on aniseed"—*Father O'Neil*).

The three examples upon which the description is founded appear to be all females.

*12. SCIOBIUS GRANIPENNIS Boh.

S. granipennis Boh. op. cit. vii. 1, p. 200 (1843).
S. deplanatus Boh. l. c. p. 201.

Long. $4\frac{4}{5}$–$5\frac{3}{5}$, lat. 3–$3\frac{3}{5}$ mm.

Head transverse, black, bare, distinctly and longitudinally plicate; forehead convex and without impressions; eyes moderately prominent. *Rostrum* a little longer than broad, sides subparallel; genæ scarcely dilated, bluntly angulate at apex, similar in the two sexes; upper surface plane, longitudinally plicate, with three narrow carinæ, the outer ones often indistinct. *Antennæ* long and slender, piceous, or piceous with the funicle ferruginous, with very fine thin pale pubescence; scape subcompressed, strongly bisinuate, rather abruptly clavate, funicle with the third joint much longer than the first, subterminal ones elongate. *Prothorax* very short, strongly transverse, basal margin arcuate or subbisinuate, sides rounded, broadest near base, broadly constricted near apex, which is truncate and much narrower than the base; upper surface convex, closely set with small depressed granules and with a short longitudinal impression on each side of the base; colour black, granules bare, the interstices with fine grey pubescence, which is denser laterally. *Elytra* suborbicular, jointly sinuate at base, sides strongly rounded, broadest at middle; upper surface convex in ♀, subdepressed in ♂, punctato-striate, with the striæ deeper laterally and containing rows of shallow punctures separated by small granules, the dorsal intervals broad and almost plane, smooth and coriaceous, the lateral ones subconvex, the seventh and eighth bearing rows of granules, which are sharp and prominent in the ♀, but inconspicuous in the ♂; colour black, with very sparse, fine, setiform, grey scaling. *Legs* slender, thicker in the ♂, piceous, with thin pale pubescence, the anterior pairs of tibiæ broader and more strongly curved in the ♂.

TYPES ♂ ♀ in the Stockholm Museum.

PONDOLAND: Port St. John (*G. Shortridge*).

Including the types, I have seen only one ♂ and three ♀ ♀ of this species; yet I have little doubt that the *deplanatus* of Boheman must be regarded as the ♂ of his *granipennis*, for the differences in the shape of the legs and elytra are evidently of a sexual character only.

The almost circular elytra and the strongly narrowed thorax give this species a very distinct appearance; when viewed from above the elytra of the ♀ appear to be crenulated all round owing to the sharp lateral granulation.

13. SCIOBIUS PLANIPENNIS, sp. nov. (Plate XVIII. fig. 7.)

Long. ♂ 7$\frac{3}{5}$, ♀ 9; lat. ♂ 3$\frac{3}{5}$, ♀ 5 mm.

Head transverse, slightly convex, rather coarsely striolato-punctate, with thin pale pubescence; forehead not impressed; eyes convex but not prominent. *Rostrum* distinctly longer than broad, sides subparallel; genæ rounded and scarcely dilated, similar in the two sexes; upper surface plane, confluently punctured, tricarinate, the outer carinæ straight and parallel. *Antennæ* elongate, piceous, with pale grey pubescence; scape compressed, distinctly sinuate and gradually broadened from base to apex; funicle with third joint much longer than first, terminal joints elongate and distinctly clavate. *Prothorax* distinctly transverse, subtruncate at base and apex, narrow apically, sides slightly rounded, broadest rather before middle; upper surface subdepressed, closely set with low granules, with a very shallow central furrow and a deep longitudinal impressed line on each side of base; colour black, with very thin pale pubescence, which is denser and yellowish laterally. *Elytra* ovate in the ♂, broadly ovate in ♀, gently sinuate at base, sides evidently rounded, broadest about middle; upper surface depressed, with deep granulated striæ, the intervals slightly convex, coriaceous and with rows of small much depressed granules, which are more evident on the declivity; colour piceous, with very fine grey pubescence, which is a little more dense apically and laterally, and also forms a denser transverse band across the summit of the declivity. *Legs* elongate and rather stout, piceous, and with fairly dense grey pubescence; anterior tibiæ distinctly compressed in both sexes, strongly curved near apex in ♂, slightly so in ♀.

Type, ♀ in the British Museum, ♂ in the South-African Museum.

Natal: Ifafa Mouth (*C. N. Barker*). Pondoland: Port St. John's.

*14. Sciobius lateralis Boh.

S. lateralis Boh. op. cit. vii. 1, p. 201 (1843).

"As long as *Sciobius porcatus*, but half as wide again, with the elytra less convex.

"*Head* short and broad, slightly convex above, longitudinally rugulose, black, sparsely clothed with greenish-grey scales, separated from rostrum by a deep arcuate impression; eyes rounded, black, moderately prominent. *Rostrum* scarcely narrower and a little longer than head, stout, porrect, almost plane above, tricarinate, obsoletely ruguloso-punctate, with grey scaling. *Antennæ* long, black, with sparse grey pubescence; scape reaching beyond the apex of the thorax, compressed, somewhat arcuate in the middle; funicle elongate, very slender, the club oblong, narrow and acuminate. *Thorax* broad, very short, truncate at base and apex, narrower anteriorly, the sides roundly ampliated; upper surface moderately convex, closely tuberculate throughout, with a longitudinal impression on each side from base to middle; black, with sparse bright greenish scaling which is denser laterally. Scutellum scarcely visible. *Elytra* subovate, truncate anteriorly, scarcely broader than the base of the thorax, somewhat dilated from base to middle, shoulders sub-rectangular and not elevated; narrower behind, almost conjointly acuminate at apex, four times as long as the thorax, slightly convex dorsally, declivous behind, sub-sulcate, the sulci with shallow punctuation, the intervals convex, transversely rugose and tuberculate; black, with bright greenish scaling which is sparse dorsally, but dense on the inflexed margins. Body finely granulate beneath, black, scattered with bright greenish scales. *Legs* elongate, stout, piceous, with sparse grey scaling and pubescence; femora clavate, unarmed; anterior tibiæ somewhat curved towards apex; tarsi moderately dilated, spongy and fuscous beneath."

"Cape of Good Hope (*Drège*)."

Type missing; in Drège's collection.

This is evidently a well-defined species, but I have been unable to find it among the material at my disposal. The description is transcribed from Boheman. In general structure it would appear to come nearest to *planipennis*, but the green scaling is a very distinctive feature.

15. Sciobius tenuicornis, sp. nov. (Plate XVIII. fig. 9.)

Long. $8\frac{4}{5}$–10, lat. $4\frac{1}{2}$–$4\frac{4}{5}$ mm.

Head moderately transverse, with shallow confluent punctuation and thin grey pubescence, which is denser beneath and round the eyes; forehead almost plane, scarcely impressed in middle; eyes convex, but hardly prominent. *Rostrum* longer than broad, basal margin obtusely angulate, sides parallel to near apex, genæ rounded and slightly dilated; upper surface plane, confluently punctured, tricarinate, the outer carinæ straight and parallel to near apex, then rapidly divergent. *Antennæ* very long and slender, piceous, with fine grey pubescence; scape narrow, subcylindrical, distinctly curved at middle and abruptly clavate; funicle with third joint longer than first, terminal joints very elongate. *Prothorax* moderately transverse, truncate at base and apex, the latter a little narrower, sides slightly rounded, broadest about middle; upper surface slightly convex, rather closely set with small, often elongate, granules, and with a very shallow rounded impression on each side near base; colour black, with thin greyish or yellowish pubescence which is denser laterally. *Elytra* broadly ovate, gently sinuate at base, subacuminate at apex, sides strongly rounded, broadest before middle; upper surface depressed, but slightly convex, steeply declivous behind and subcompressed before apex, with distinct striæ containing shallow punctures, separated by small granules and continued to near apex, the intervals of equal width, rather broad, almost plane and distinctly coriaceous; colour black or piceous brown, almost bare above, the inflexed margins with a very broad continuous stripe of dense yellowish pubescence. *Legs* long and slender, black, or ferruginous brown with the knees and tarsi black; anterior tibiæ straight externally, the tarsi rather elongate.

TYPE ♀ in the British Museum.

NATAL. ZULULAND: Eshowe (*A. Windham*).

*16. Sciobius latipennis Fåhr.

S. latipennis Fåhr. op. cit. p. 30.

Long. $6\frac{3}{5}$, lat. $3\frac{4}{5}$ mm.

Head moderately transverse, piceous, aciculate; scaling whitish, sparse, but forming a dense ring round the eye; forehead plane and with a shallow central impression; eyes not very prominent. *Rostrum* scarcely longer than broad, subquadrate, sides gently sinuate, genæ only slightly and roundly dilated; upper surface plane, with three narrow carinæ, the central one lower and not reaching the base, the outer ones subparallel, finely aciculate and with sparse pale scaling. *Antennæ* slender, piceous, with thin pale pubescence; scape distinctly bisinuate, compressed and gradually thickened to apex; third joint of funicle much longer than first, subterminal joints elongate. *Prothorax* very transverse, the base broadly rounded, sides straight and rapidly converging from base to apex, which is truncate, posterior angles acute; upper surface rather convex, moderately closely granulate, with a shallow depression on each side near the base; colour black, granules bare, the interstices with yellowish-white scaling which is denser laterally. *Elytra* broadly ovate, acuminate posteriorly, jointly sinuate at base and a little broader than the prothorax, shoulders acute, sides strongly rounded, broadest before middle; upper surface slightly convex, the suture distinctly elevated and the sides strongly inflexed, the striæ deep laterally but shallower on disk, containing rows of shallow punctures separated by minute granules; the intervals finely coriaceous and with a few scattered granules on the declivity; interval 1 elevated, 2 plane, broader than the rest and subdepressed near base, 3 and 4 slightly convex, 5, 6, and 7 narrower and subcarinate, those on the inflexed margin plane; colour piceous, almost bare, with very fine thin grey scaling. *Legs* slender, piceous, with fine short white pubescence, the anterior tibiæ only slightly curved.

TYPE ♀ in the Stockholm Museum.

CAFFRARIA (*J. Wahlberg*).

The type is the only example which I have seen of this species. The strong lateral inflection of the elytra, in conjunction with the elevated suture and depressed second interval, gives the insect a very distinctive facies.

17. SCIOBIUS ACICULATIFRONS Boh.

S. aciculatifrons Boh. op. cit. vii. 1, p. 198 (1843).

Long. $5\frac{1}{5}$–$5\frac{3}{5}$, lat. $2\frac{3}{5}$–$2\frac{4}{5}$ mm.

Head moderately transverse, convex, finely and longitudinally plicate, with thin grey scaling; forehead without impressions; eyes not prominent. *Rostrum* about as long as broad, sides subparallel to near apex, genæ slightly and roundly dilated; upper surface plane, rugosely punctured, with three fine carinæ, the outer ones straight and parallel. *Antennæ* moderate; piceous, with fine grey pubescence; scape broad, compressed, strongly curved and gradually dilated to apex; funicle comparatively short, the third joint longer than the first, the outer ones elongate but subconical. *Prothorax* twice as broad as long, arcuate at base, apex truncate and much narrower, sides subangulate near base and rapidly narrowed from there to apex; upper surface evenly coriaceous, without any lateral basal impressions; colour black, with thin grey scaling which is rather denser beneath. *Elytra* ovate, somewhat acuminate posteriorly, jointly sinuate at base, sides moderately rounded, broadest before middle; upper surface not very convex, with fine striæ containing rows of close punctures, the intervals almost plane, smooth and impunctate; colour black, evenly covered with fine and not very dense grey scaling. *Legs* moderately long and stout, piceous, with the tibiæ paler and covered with thin grey pubescence, the anterior tibiæ broad and distinctly curved at apex, the interior edge bisinuate.

TYPE ♂ in the Stockholm Museum.

NATAL: Estcourt (*A. E. Haviland*). CAPE COLONY: Kentani (*Rev. Dr. Kolbe*).

I have seen only four examples, all of which appear to be males. In the unique type the second interval of the elytra is not dilated, but in two other examples this is the case to a slight extent. The curvature of the anterior tibiæ and the lateral inflection of the elytra also vary somewhat. It is possible that two species are involved, but they cannot be satisfactorily discriminated without further material.

18. SCIOBIUS BARKERI, sp. nov. (Plate XVIII. fig. 8.)

Long. 5–6, lat. $2\frac{2}{5}$–3 mm.

Head transverse, convex, finely aciculate, with thin pale setiform scaling forming a dense ring round the eyes, which are not very prominent; forehead with a shallow central impression. *Rostrum* short, as long as the width at base, gradually narrowed towards apex, the genæ rounded and not dilated; upper surface plane, aciculate, and with fine pale setiform scaling, with three narrow carinæ, the outer pair straight and parallel, the apical emargination very deep and acute. *Antennæ* slender, piceous, with fine pale pubescence; scape subcompressed, strongly curved and gradually dilated to apex; funicle with the third joint a little longer than the first, subterminal joints elongate. *Prothorax* twice as broad as long in the ♀, a little less transverse in the ♂, distinctly arcuate at base, narrower and truncate at apex; sides slightly rounded in the ♀, more so in the ♂, broadest rather behind middle; upper surface convex, set with scattered depressed granules and without any lateral impressions; colour black, with thin grey or yellowish setiform scaling which is dense beneath and usually forms three denser lines above. *Elytra* ovate in the ♀, narrower and more acuminate posteriorly in the ♂, jointly sinuate at base, sides gently rounded in the ♀, less so in the ♂, broadest about middle; upper surface slightly convex, with fine striæ containing shallow punctures separated by small granules, the intervals smooth and devoid of granules, in the ♀ broad and slightly convex; the second interval is also much dilated and depressed near the base, thus causing the third interval to appear strongly sinuate in its basal half; this character is only faintly indicated in the ♂, which has all the intervals narrower and more convex; colour black, somewhat thinly covered with minute pale scaling which is denser towards the sides and apex, the scales with either a yellow, pinkish, or green reflection. *Legs* slender, piceous, with fine pale pubescence, the anterior tibiæ slightly curved in the ♀, a little more strongly so in the ♂.

Type, ♀ in the British Museum, ♂ in the Oxford Museum.

Natal: Malvern (*C. N. Barker*).

A very distinct little species. The dilated portion of the second interval in the ♀ is distinctly flattened and more densely covered with scales. The ♂ comes nearest to *aciculatifrons* Boh., but the forehead is not striolate, the scape is much more slender, and the elytra are scarcely inflexed laterally.

19. SCIOBIUS SCAPULARIS Boh.

S. scapularis Boh. op. cit. vii. 1, p. 195 (1843).

Long. $5\frac{3}{5}$–8, lat. 3–$4\frac{2}{5}$ mm.

Head convex; forehead not impressed, finely plicate; eyes not prominent. *Rostrum* subquadrate, about as long as broad, base trisinuate or biangulate; genæ not dilated in ♀, slightly and roundly dilated in ♂; upper surface plane, finely punctured and distinctly tricarinate, the outer carinæ parallel to middle and with a slight outward curve apically. *Antennæ* moderately long, piceous, with fine grey scaling; scape compressed, broad, distinctly bisinuate and gradually dilated to apex; funicle with the third joint much longer than the first. *Prothorax* very transverse, distinctly arcuate or even subangulate at base, much narrower and faintly sinuate at apex; sides scarcely rounded, broadest close to base and rapidly narrowed to apex; upper surface slightly convex, rather sparsely set with very depressed and sometimes obsolescent granules, the sides of the disk with a shallow and ill-defined depression; colour black, with thin whitish scaling which is denser laterally and beneath. *Elytra* broadly ovate, jointly sinuate at base, sides moderately rounded, broadest before middle; upper surface convex, the striæ containing distinct punctures which disappear behind middle, the intervals almost plane, of equal width, smooth and without a trace of granules, very finely aciculate; colour piceous black, with fine thin grey scaling (usually abraded), which is denser laterally. *Legs* moderate, piceous, with fine grey scaling, the anterior pairs of tibiæ slightly more curved in the ♂, and with the inner angle a little more produced than in the ♀.

Type, missing; in Ecklon and Zeyher's Collection.

Cape Colony: Grahamstown (*Mrs. G. White, Miss Daly*, and *Dr. Chew*).

20. SCIOBIUS GRISEUS Gyl.

S. griseus Gyl. Schönh. Gen. Curc. ii. p. 536 (1834).

Long. ♂ 6–$7\frac{3}{5}$, ♀ $6\frac{4}{5}$–$7\frac{3}{5}$; lat. ♂ $3\frac{1}{2}$–$4\frac{1}{5}$, ♀ 4–$4\frac{2}{5}$ mm.

Head moderately transverse, convex, rugosely punctured, with sparse grey scaling; forehead plane, without impressions; eyes not prominent. *Rostrum* a little longer than broad, its basal margin arcuate, sides parallel in the basal half; genæ slightly and roundly dilated in the ♂, scarcely produced in the ♀; upper surface plane, rugosely punctured, distinctly tricarinate, the outer carinæ parallel to middle, then curving outwardly. *Antennæ* comparatively short, piceous, with fine grey scaling; scape broad, strongly compressed, dilated from base to near middle, the sides subparallel from there to apex, upper surface rugosely punctured and with a shallow sulcus; funicle with the third joint a little longer than the first, terminal joints not very elongate, subconical. *Prothorax* strongly transverse, subtruncate at base, narrower and gently sinuate at apex, sides almost straight from base to beyond middle, thence rapidly narrowed to apex; upper surface slightly convex, with close depressed and sometimes confluent granulation; colour black, with sparse grey scaling which is denser laterally. *Elytra* very broadly ovate in ♂, globose in ♀, subtruncate or slightly sinuate at base, sides strongly rounded, broadest about middle; upper surface convex in ♀, more plane in ♂, with deep striæ containing distinct granules which are continued right up to apex; the intervals of equal width, almost plane, smooth, and coriaceous, but with a few obsolescent granules on the declivity; colour black, piceous, or dark ferruginous, with uniform thin grey scaling, which is condensed into paler patches along the inflexed margins. *Legs* moderately long and stout in ♂, shorter in ♀, piceous or ferruginous, with sparse grey scaling; anterior tibiæ straight externally in ♀, slightly curved towards apex in the ♂.

TYPE ♂ ♀ in the Stockholm Museum.

CAPE COLONY: Uitenhage and Bedford (*Father O'Neil*); Grahamstown (*Mrs. G. White*); Steynsburg (*Miss Lippan*); Somerset East and Tsomo [S. A. Mus.].

The ♀ of this species has more strongly globose elytra than any other in the genus, although the ♀ of *pullus* approaches it nearly; but the latter may be distinguished by its much more slender scape and longer and more slender funicle.

21. SCIOBIUS PULLUS Sparrm.

♀. *Curculio pullus* Sparrm. Act. Holm. 1785, p. 56, pl. 3. fig. 38.

♂. *S. cinctus* Boh. op. cit. vii. 1, p. 196 (1843).

♂. *S. varius* Boh. l. c. p. 197.

Long. ♂ $5\frac{1}{5}$–6, ♀ $5\frac{1}{5}$–$6\frac{4}{5}$; lat. ♂ $2\frac{3}{5}$–3, ♀ $3\frac{2}{5}$–4 mm.

Head moderately transverse, convex, rugosely punctured and with thin grey scaling; forehead plane but not impressed; eyes slightly prominent. *Rostrum* longer than broad, with the base arcuate, sides subparallel to beyond middle, genæ slightly and roundly dilated, similar in the two sexes; upper surface plane, rugosely punctured, distinctly tricarinate, the outer carinæ subparallel to beyond middle and then curved outwardly. *Antennæ* long and slender, piceous, with fine grey scaling; scape not compressed, strongly curved, rather abruptly clavate; funicle with the third joint a little longer than the first, subterminal joints elongate. *Prothorax* strongly transverse, truncate at base and apex, the latter narrower, sides slightly rounded (but sometimes almost straight in the posterior half), broadest about middle and with a shallow constriction close to apex; upper surface convex, closely set with small granules and without impressions; colour piceous, with fine grey scaling, which is sparse dorsally and denser on the sides. *Elytra* broadly ovate in the ♂, subglobose in the ♀, subtruncate at base; sides very strongly rounded in the ♀, less so in the ♂, broadest about middle: upper surface convex, with deep striæ containing shallow punctures separated by small granules; the intervals convex, smooth, coriaceous, with a few small granules on the declivity; in the ♀ there are usually irregular rows of granules on intervals 7 and 8, which may often be seen from above in the form of a lateral crenulation; colour piceous, with fine grey scaling, which in the ♂ forms the following markings: a dense irregular lateral stripe, a sublunulate transverse band above declivity, some small irregular spots on the disk, and occasionally a well-defined sutural stripe (var. *cinctus* Boh.): in the ♀ the scaling is more evenly distributed and these markings are only vaguely indicated, but the sutural stripe is never present. *Legs* moderate, the anterior tibiæ straight externally and slightly sinuate internally in ♀, in ♂ broader, curved externally near apex and strongly sinuate internally.

TYPE ♀ in the Stockholm Museum. TYPES of *cinctus* and *varius* also in the same Museum.

CAPE COLONY: Uitenhage and Port Alfred (*Father O'Neil*), Kowie and Grahamstown [S. A. Mus.]. PONDOLAND: Port St. John (*G. Shortridge*).

After a very careful examination of Boheman's types of *cinctus* and *varius* together with a further series of ten specimens, I can find no reliable specific character by which the two forms may be differentiated. Both the thorax and elytra vary somewhat in their outline, as also does the curvature of the rostral carinæ, but these characters all vary independently of each other, and the variations show such gradations as to render them useless as specific characters. That these two forms represent the male sex of Sparrman's *pullus* there can, I think, be but little doubt. Of the latter form I have seen eleven examples, and these exhibit variations in the shape of the thorax and elytra similar to those observable in the males.

22. SCIOBIUS POLLINOSUS Fåhr.

S. pollinosus Fåhr. op. cit. p. 29.

Long. 6–6$\frac{3}{5}$, lat. 2$\frac{2}{5}$–3$\frac{1}{5}$ mm.

Head a little shorter than its width at base, black, with scattered shallow punctuation and sparse yellowish pubescence; forehead with a slight central impression; eyes moderately prominent. *Rostrum* distinctly longer than broad, its sides subparallel, the genæ only slightly and roundly dilated in both sexes; upper surface impressed, tricarinate, the carinæ straight and parallel, the punctuation and pubescence as on the head. *Antennæ* very long and slender, piceous, with fine grey pubescence; scape slender, subcylindrical, slightly curved and abruptly clavate, funicle with the third joint much longer than the first. *Prothorax* rather transverse, rounded at the base, narrower and truncate at the apex, sides slightly rounded, broadest about middle; upper surface convex, closely set with low rounded granules, but with a more or less distinct smooth central line: colour black, the granules bare, the interstices with fine grey pubescence bearing an evanescent yellow powdering, which is denser at the sides and along the base. *Elytra* ovate, a little broader than the prothorax at the base, which is jointly sinuate; sides rounded, broadest rather before middle, narrower in the ♂; upper surface convex, with distinct striæ, which, according to the incidence of the light, appear to contain either rows of subquadrate punctures or rows of small granules, both of which vanish on the declivity; intervals slightly convex, of approximately equal width and evenly raised, almost impunctate and without tubercles, with thin very fine pubescence bearing a yellowish or reddish powder, which is easily removed and is only observable at the sides and apex, but in perfect specimens it would doubtless occur all over the disk. *Legs* moderately long and slender, black or piceous, with fine grey pubescence; the anterior pairs of femora more strongly clavate in the ♂, the anterior tibiæ scarcely curved interiorly and similar in the two sexes; the first joint of the tarsi broad and elongate, about as long as the next two together.

TYPE in the Stockholm Museum.

NATAL: Howick (*Dr. F. Dimock Brown*).

The unusual development of the first tarsal joint is a good distinctive character. I have seen only three examples of the species.

*23. SCIOBIUS MARGINATUS Fåhr.

S. marginatus Fåhr. op. cit. p. 28.

Long. ♂ $8\frac{1}{2}$–$8\frac{4}{5}$, ♀ $8\frac{4}{5}$; lat. ♂ $3\frac{3}{5}$, ♀ $4\frac{2}{5}$ mm.

Head almost as long as broad, vertex convex and finely aciculate forehead shallowly punctate and with a broad median impression; colour piceous or ferruginous with sparse pale pubescence, forming a denser ring round the eyes, which are slightly prominent. *Rostrum* longer than broad, basal margin distinctly angulate, sides parallel to near apex, genæ slightly and roundly dilated in both sexes; upper surface slightly impressed, distinctly tricarinate, the outer carinæ parallel to near apex, then rapidly divergent, the interspaces finely rugose and with thin pale pubescence. *Antennæ* moderate, piceous, with grey pubescence; scape subcompressed, strongly curved and gradually dilated to apex; funicle slender, third joint longer than first. *Prothorax* in ♂ a little broader than long, truncate at base and apex, the latter narrower and broadly but shallowly constricted; sides almost straight, broadest at base and very slightly narrowed from there to the apical constriction; in ♀ a little more transverse, sides slightly rounded and the apical constriction less evident; upper surface subdepressed, granulation very variable, usually depressed and subconfluent, occasionally subobsolescent, sometimes with a faint, rounded, very shallow impression on each side not far from base; colour piceous, with fine grey pubescence, denser laterally and there bearing a bright yellow powdering, which, however, is easily abraded. *Elytra* in ♂ very narrowly ovate, truncate or slightly emarginate at base, constricted behind the shoulders, which have an acute tubercular prominence; sides moderately rounded, broadest about middle, rounded apically; in ♀ broadly ovate, slightly sinuate at base, shoulders normal and not prominent, sides more strongly rounded, subacuminate apically; upper surface slightly convex or subdepressed, steeply declivous and distinctly retuse posteriorly, especially in ♀, with distinct striæ containing shallow punctures separated by small granules, the intervals almost plane, coriaceous and devoid of granules; colour piceous or castaneous, with very fine thin grey pubescence, the inflexed margins with a broad stripe of denser pubescence having a bright yellow powdering; there is also a similar but narrower sutural stripe extending from base to near apex. *Legs* slender and elongate, piceous, or ferruginous with the knees and coxæ darker, with fine grey pubescence; anterior tibiæ straight externally in both sexes.

TYPE ♂ in the Stockholm Museum.

NATAL: Malvern (*C. N. Barker*), Howick (*Dr. F. Dimock Brown*).

Apart from the type I have seen only a single ♂ and ♀, which I refer provisionally to this species. The former, however, differs from the type in having the shoulders merely subrectangular and without any distinct tubercular prominence, the constriction of the prothorax being less marked and the sutural stripe wanting. But without more material it is difficult to say whether these are specific or merely varietal characters.

24. SCIOBIUS SPATULATUS, sp. nov. (Plate XVIII. fig. 10.)

Long. $6\frac{2}{5}$, lat. $3\frac{2}{5}$ mm.

Head very short, strongly transverse, slightly convex, aciculate and with sparse yellowish pubescence forming a denser ring round the eyes, which are not prominent, forehead with a shallow central impression. *Rostrum* longer than broad, arcuate at base, sides sinuate, genæ rounded and scarcely dilated; upper surface shallowly impressed, tricarinate, the outer carinæ curved and higher than the central one, aciculate and with pale setiform scaling which is denser beneath. *Antennæ* piceous, with fine grey pubescence; scape compressed, broadly dilated, subfusiform, with a distinct central carina above and bisulcate beneath; funicle long and slender, the third joint much longer than the first, the subterminal joints elongate, subconical. *Prothorax* subcylindrical, as long as its width at apex, which is truncate, base a little broader and subtruncate, the sides linear; upper surface slightly convex, evenly set with low, rather distant granules and without lateral impressions; colour piceous, granules bare, the interstices with thin yellowish pubescence which is denser laterally. *Elytra* pyriform, slightly emarginate at base, which is a little broader than the prothorax, the humeral angles obtuse, sides strongly rounded, broadest well behind middle; upper surface convex, the striæ containing rows of shallow punctures separated by small granules, the intervals almost plane, subequal in width on the disk, finely coriaceous and with traces of depressed obsolescent granules, especially near apex; colour piceous, with thin minute grey scaling which is denser and yellowish along the inflexed margins. *Legs* ferruginous, with thin grey pubescence, the anterior tibiæ only slightly curved.

TYPE in the British Museum.

NATAL: Lower Tugela (*E. Reynolds*—Brit. Mus.).

Founded on two specimens of uncertain sex. In general facies this insect is like an elongated *bistrigicollis*, but the very broad and carinate scape will at once distinguish it from all its congeners.

*25. SCIOBIUS PÉRINGUEYI, sp. nov. (Plate XVIII. fig. 11.)

Long. $8\frac{2}{5}$, lat. $2\frac{1}{5}$ mm.

Head moderately transverse, slightly convex, finely coriaceous, with fine pale scaling which is denser round the eyes; forehead shallowly depressed in middle; eyes slightly prominent. *Rostrum* longer than broad, its basal margin sharply angulate, sides subparallel to near apex, genæ rounded and slightly dilated; upper surface plane, coriaceous, finely tricarinate, the outer carinæ straight and parallel. *Antennæ* moderately long and slender, piceous, with dense fine grey pubescence; scape not compressed, but strongly curved about middle and subclavate beyond the curve; funicle with the first and third joints subequal. *Prothorax* rather broader than long, truncate at base and apex, the latter being a little narrower, sides slightly rounded, broadest about middle; upper surface convex, set with rather distant depressed granules and without any impressions; colour piceous, with thin grey scaling dorsally and with dense yellow scaling laterally and beneath. *Elytra* ovate, truncate at base, subacuminate apically, a little broader than the prothorax at the shoulders, which are subrectangular and slightly prominent, sides moderately rounded, broadest rather before middle; upper surface convex and gradually declivous behind, with broad striæ containing rows of large shallow punctures separated by small granules and disappearing on the declivity; the intervals of equal width, narrow, slightly convex and coarsely coriaceous but without any distinct granulation; colour piceous, with fine yellow scaling, which is thin dorsally, except round the scutellum, but forms a broad and dense lateral stripe which emits inwardly an oblique pointed band nearly reaching the suture at the summit of the declivity. *Legs* ferruginous, with the tarsi fuscous; the anterior tibiæ slightly curved at the extreme apex.

TYPE in the South African Museum.

TRANSVAAL: Leydenburg (*T. Ayres*).

26. SCIOBIUS VIDUUS, sp. nov. (Plate XIX. fig. 1.)

Long. $8\frac{2}{5}$, lat. $4\frac{3}{5}$–$4\frac{4}{5}$ mm.

Head transverse, almost plane above, rugosely punctured and with fine scaling; forehead not impressed; eyes slightly prominent. *Rostrum* longer than broad, the basal margin sharply angulate, sides subparallel, genæ rounded and scarcely dilated; upper surface plane, rugosely punctured, tricarinate, the outer carinæ straight and parallel to near apex, then gently diverging. *Antennæ* moderate, piceous, with thin grey pubescence; scape comparatively slender, subcompressed, only slightly curved about middle and gradually thickened to apex; funicle with the first and third joints subequal. *Prothorax* moderately transverse, subtruncate at base, apex distinctly narrower and faintly sinuate, sides scarcely rounded, broadest at base and gradually narrowing to apex; upper surface slightly convex, moderately closely set with distinct low granules and with a faint ill-defined impression on each side a little behind middle; colour black, with fine pale scaling which is denser laterally and beneath. *Elytra* broadly subpyriform, slightly sinuate at base, sides rounded, broadest well behind middle; upper surface broadly depressed and very steeply declivous posteriorly, with broad striæ containing rows of large shallow punctures separated by small granules, the intervals rather narrow, slightly convex and strongly coriaceous; colour black or castaneous, with thin pale scaling dorsally and a broad uniform lateral band of denser scaling. *Legs* moderately long and rather slender, piceous or castaneous, with fine pale pubescence, the anterior tibiæ straight.

TYPE ♀ in the British Museum.

TRANSVAAL.

This species is founded on two females sent me by Dr. W. Horn. It is nearly allied to *marginatus* Fåhr., from which, however, it may at once be distinguished by the very differently shaped elytra, the more coarsely punctured striæ, and the much less curved scape.

27. SCIOBIUS PONDO, sp. nov. (Plate XIX. fig. 3.)

Long. $10\frac{1}{5}$–12, lat. $5\frac{1}{5}$–$5\frac{4}{5}$ mm.

Head strongly transverse, piceous, with a few short pale setæ, aciculate on vertex; forehead finely plicate, without any central impression or supra-ocular tubercle; eyes prominent. *Rostrum* quadrate, distinctly longer than broad, sides subparallel; genæ not dilated, bluntly rectangular at apex, similar in the two sexes; upper surface impressed, tricarinate, the three carinæ parallel, the central one lower than the others, the punctuation shallow and indefinite; colour black or piceous with a few short pale setæ

Antennæ comparatively long and slender, piceous, with sparse pale setæ; scape slender, subcylindrical, rather abruptly clavate, slightly curved, the third joint of the funicle scarcely longer than the first, the three subterminal joints much longer than broad. *Prothorax* slightly transverse in the ♂, more so in the ♀, truncate at base and apex, sides subparallel from base to far beyond middle, thence rapidly narrowed to apex; upper surface slightly convex but flattened on the disk, somewhat sparsely set with small low smooth tubercles, most of which are rounded but some elongate; colour black or piceous, the discal area bare, the sides and prosternum with moderately dense depressed yellow setæ. *Elytra* ovate, subacuminate apically in both sexes, but a little broader in the ♀, jointly sinuate at base, shoulders very oblique, sides moderately rounded, broadest before middle; upper surface convex, subcompressed on the declivity so that the suture is there rather prominent, with shallow striæ containing rows of shallow separated punctures, the intervals slightly convex, of approximately equal width on the disk, finely aciculate, and bearing scattered irregular low tubercles which in some parts make the elytra appear to be transversely rugose; colour black or piceous, almost bare on the disk but with the sides somewhat densely clothed with yellow setiform scaling; on the apical half the intervals bear rows of long erect pale setæ. *Legs* dark ferruginous, the trochanters, knees, and tarsi black, covered with sparse pale setæ, thicker in the ♂ than in the ♀, and with all the tibiæ broader and more strongly curved.

TYPE, ♀ in the British Museum, ♂ in the South African Museum.

PONDOLAND: Port St. John (*G. Shortridge*).

Resembling a large *tottus* Sparrm. in appearance, but the scape is shorter, stouter, and less strongly clavate, and the granulation of the elytra is coarser. The presence of long erect setæ is also a distinctive character, being very unusual in the genus.

28. SCIOBIUS TOTTUS Sparrm.

Curculio tottus, Sparrm. Act. Holm. 1785, p. 50, t. 2. f. 21.
S. tottus, Gyl. Schönh. Gen. Curc. ii. p. 535 (1834).
S. porcatus Gyl. l. c. p. 535.

Long. ♂ 8–8$\frac{2}{5}$, ♀ 8$\frac{2}{5}$–10; lat. ♂ 3$\frac{1}{5}$–3$\frac{3}{5}$, ♀ 3$\frac{4}{5}$–4$\frac{4}{5}$ mm.

Head transverse, convex, with close shallow punctuation and thin grey scaling; forehead scarcely impressed in middle; eyes not very prominent. *Rostrum* rather longer than broad, basal margin angulate, sides subparallel to near apex, genæ slightly and roundly dilated, similar in the two sexes; upper surface plane, with scaling and punctuation as on the head, tricarinate, the outer carinæ parallel to near apex, then divergent. *Antennæ* very long and slender, piceous, with fine grey pubescence; scape elongate, regularly curved, cylindrical, abruptly clavate; funicle with the third joint scarcely longer than the first, the subterminal joints elongate and scarcely broader apically. *Prothorax* moderately transverse in ♂, more so in ♀, slightly arcuate at base, narrower and truncate at apex, sides subparallel from base to about middle, then roundly narrowed to apex; upper surface convex, set with low rounded or confluent granules which are often more sparse on the disk, with a variable central carina which is sometimes complete and distinct, but usually more or less abbreviated or even entirely absent; colour piceous, the granules bare, the interstices with grey or yellowish scaling which is denser laterally. *Elytra* narrowly ovate in the ♂, broader in the ♀ and more acuminate posteriorly, slightly sinuate at base, sides rounded, broadest before middle; upper surface convex, with broad striæ containing shallow punctuation separated by small granules; the interstices convex, of equal width, closely and irregularly set with small low and usually confluent granules, often giving them a transversely rugose appearance; colour piceous or black, with fine grey or yellowish scaling, which is very thin on the disk but rather denser along the inflexed margins. *Legs* rather long and slender, piceous or ferruginous, with very fine pale scaling, the exterior edge of the anterior tibiæ straight in the ♀, distinctly curved close to apex only in the ♂.

TYPES ♂ ♀ in the Stockholm Museum.

CAPE COLONY: Grahamstown [Oxf. Mus.]. ORANGE RIVER COLONY: Bloemfontein (*Miss Wilman*—Camb. Mus.).

Although I have no evidence as to the insects actually being taken *in copulâ*, I can have no doubt that *porcatus* Gyl. is the ♀ of *tottus* Sparrm., the characters distinguishing them being evidently sexual. Including the typical specimens from Stockholm, I have seen six *porcatus* and four *tottus*.

*29. SCIOBIUS MURICATUS Boh.

S. muricatus Boh. op. cit. vii. 1, p. 193 (1843).

"Almost half as small as *Sciobius tottus*, more convex; thorax very short; the intervals of the elytra remotely tuberculate posteriorly: these characters will at once distinguish it from the preceding species [*tottus* and *porcatus*].

"*Head* short and broad, almost plane above, vertex finely and closely punctured; forehead rugosely striolate, entirely piceous, and with sparse grey scaling, separated from the rostrum by a deep angulated impression; eyes sub-rotundate, slightly prominent, brownish black. *Rostrum* a little narrower and longer than the head, stout, porrect, almost plane above, tricarinate, obsoletely punctulate, piceous black, and with denser grey scaling. *Antennæ* inserted towards the apex of rostrum, longer than half the body, slender, piceous and sparsely pubescent, the club narrow, acuminate. *Thorax* very short, transverse, truncate at base and apex, a little narrower anteriorly, obsoletely constricted close to apex; sides not ampliated, almost straight; upper surface slightly convex, obsoletely tuberculate throughout, piceous black, with the anterior margin paler, sparsely covered with grey scaling. Scutellum minute, scarcely visible. *Elytra* truncate anteriorly, scarcely broader than the base of the thorax, but obliquely ampliated a short distance behind the base; shoulders rounded, not elevated, narrowed from middle to apex, jointly subacuminate at apex, five times as long as the thorax; upper surface strongly convex, moderately declivous behind, sub-sulcate, the sulci with obsolete punctures; all the intervals elevated, convex, and with distinct remote tubercles posteriorly; entirely ferruginous, variegated with grey and fuscous scaling. Body obsoletely punctulate beneath, piceous, with sparse grey scaling. *Legs* elongate, stout, ferruginous, with sparse grey scaling and pubescence; femora moderately clavate, unarmed; tibiæ straight; tarsi moderately dilated, spongy and grey beneath.

"CAPE OF GOOD HOPE (*Drège*)."

TYPE missing; in Drège's collection.

This description is a translation of that given by Boheman, as I have failed to recognise the insect among the species which I have examined.

*30. SCIOBIUS ANGUSTUS, sp. nov. (Plate XIX. fig. 2.)

Long. 6, lat. 2½ mm.

Head moderately transverse, slightly convex, evenly coriaceous and with sparse pale scaling which is denser round the eyes; forehead scarcely impressed in middle; eyes convex but not prominent. *Rostrum* longer than broad, basal margin obtusely angulate, sides parallel to near apex, genæ rounded and slightly dilated; upper surface plane, rugulose, tricarinate, the outer carinæ straight and parallel throughout. *Antennæ* elongate, but comparatively stout, piceous, with thin grey pubescence; scape compressed, moderately curved and gradually thickened to apex; funicle with the first and third joints equal. *Prothorax* moderately transverse, truncate at base and apex, sides straight from base to well beyond middle, thence rapidly narrowed to apex; upper surface somewhat convex, coriaceous, sparsely set with small granules and without distinct impressions; colour black, with fairly dense greenish-grey scaling. *Elytra* elongato-ovate, truncate at base, shoulders subrectangular, scarcely prominent but with a faint humeral tubercle, sides gently rounded, broadest about middle; upper surface convex, with rather shallow striæ containing rows of strong punctures separated by small granules, the intervals rather narrow, of equal width, coriaceous and devoid of granules; colour black, fairly densely covered with fine greenish-grey scaling; in perfect specimens this is probably uniform throughout, but in the type the discal portion is somewhat abraded. *Legs* moderate, piceous, with thin grey scaling; anterior tibiæ straight externally, the first tarsal joint elongate, longer than either of the next two.

TYPE ♂ in the South African Museum.

TRANSVAAL: Shilouvane (*Rev. H. Junod*).

A rather small, very narrow species belonging to the group represented by *marginatus* Fåhr., from which latter it may be distinguished by the more prominent central carina of the rostrum, the fine and sparse granulation of the thorax, and the narrower and more convex elytra, as well as by the very different coloration.

31. SCIOBIUS PANZANUS, sp. nov. (Plate XIX. fig. 4.)

Long. $8\frac{4}{5}$–$9\frac{1}{5}$, lat. 3–$3\frac{2}{5}$ mm.

Head transverse, almost plane above, finely rugose, and with thin scaling which is denser round the eyes; forehead without impressions; eyes rather prominent. *Rostrum* longer than broad, basal margin sharply angulated, sides faintly sinuate before middle, genæ rounded and scarcely dilated; upper surface plane, finely rugose, distinctly tricarinate, the outer carinæ straight and parallel. *Antennæ* moderate, piceous, with fine grey pubescence; scape not compressed, moderately stout, strongly curved beyond middle and subclavate beyond the curve; funicle with the first and third joints subequal. *Prothorax* rather broader than long, subcylindrical, truncate at base and apex and only a little narrower anteriorly; sides slightly rounded, broadest about middle; upper surface convex, set with small scattered granules and without any impressions; colour black, with fine greyish scaling which is denser laterally. *Elytra* regularly oval, truncate at base, rounded posteriorly, sides rounded, broadest about middle; upper surface convex and steeply declivous behind, with distinct striæ containing rows of large deep punctures which are fainter on the declivity; the intervals slightly convex, of equal width, smooth and minutely aciculate; colour black, with fine greyish scaling which is slightly denser laterally and apically, and with a denser transverse band across the summit of the declivity. *Legs* blackish, with rather dense grey pubescence; the anterior tibiæ straight externally and only slightly curved internally in the ♂.

TYPE ♂ in the British Museum.

NATAL: Umpanzi R. in Umvoti County (*C. N. Barker*).

*32. SCIOBIUS SCHÖNLANDI, sp. nov. (Plate XIX. fig. 6.)

Long. 5, lat. $2\frac{4}{5}$ mm.

Head moderately transverse, convex, bare except for a few pale scales round the eyes, forehead very finely striolate and without impressions; eyes convex but not prominent. *Rostrum* a little longer than broad, basal margin arcuate, sides straight and narrowing slightly from base to apex, genæ not dilated; upper surface plane, finely rugulose, narrowly carinate, the outer carinæ parallel to quite near apex and there rapidly diverging. *Antennæ* moderate, piceous brown with fine grey pubescence; scape subcompressed, but slender, rather sharply curved and clavate; funicle with the first and third joints subequal. *Prothorax* strongly transverse, slightly arcuate at base, truncate and distinctly narrower at apex, sides moderately rounded, broadest rather behind middle; upper surface convex, with close and fine confluent punctuation throughout, without any lateral impressions but with a shallow impressed transverse line close to apex; colour black, bare. *Elytra* broadly ovate, slightly sinuate at base, acuminate apically, sides strongly rounded, broadest much before middle; upper surface very convex, but rather gradually declivous posteriorly, with deep striæ containing rows of strong punctures the intervals of equal width, moderately broad, slightly convex, quite smooth and very finely alutaceous; colour black, rather shiny and entirely bare. *Legs* ferruginous, with the femora black; anterior tibiæ straight externally, but distinctly sinuate internally near apex.

TYPE ♀ in the Albany Museum, Grahamstown.

CAPE COLONY: Steynsburg.

Very similar to *S. nanus* in general appearance, but the scape much longer and more slender, the prothorax lacks the lateral impressions, and the elytra are distinctly acuminate apically. Whether the absence of scales is normal is not altogether certain, but there is not even a trace of them on the elytra in the type specimen.

33. SCIOBIUS VIRIDIS, sp. nov. (Plate XIX. fig. 7.)

Long. 5–$6\frac{2}{5}$, lat. $2\frac{3}{5}$–$3\frac{2}{5}$ mm.

Colour black or piceous, densely and uniformly covered above and below with bright green scaling, which varies to yellowish green or dull golden green.

Head transverse, slightly convex, with close shallow punctuation; forehead scarcely impressed; eyes not prominent. *Rostrum* scarcely longer than broad, arcuate at base, sides gradually convergent from base to beyond middle; genæ bluntly angulate, moderately produced in ♀, a little more so in ♂; upper surface shallowly impressed, tricarinate, only the central carina bare of scaling, the outer carinæ straight and gradually diverging anteriorly. *Antennæ* moderately long and slender, piceous, with fine grey scaling; scape not compressed, subcylindrical, regularly curved and gradually clavate; funicle with the first joint rather longer than third, the subterminal joints subconical and not very long. *Prothorax* strongly transverse, base faintly bisinuate, apex a little narrower and truncate, sides scarcely rounded and with a shallow constriction at apex; upper surface convex, finely and evenly coriaceous, without any lateral impressions. *Elytra* ovate, broader and rather more blunt apically in the ♀, slightly sinuate at base, sides strongly rounded, broadest about middle; upper surface very convex, with fine striæ containing small shallow punctures; the intervals rather broad, subequal in width, almost plane, smooth and impunctate. *Legs* moderate, ferruginous, with greenish or golden scaling, anterior tibiæ straight externally, thicker and with the internal angle more strongly produced in the ♂.

TYPE, ♀ in the British Museum, ♂ in the Oxford Museum.

TRANSVAAL.

Described from six specimens. One in the British Museum, two in the South African Museum, and the remaining three kindly given me by Dr. Walther Horn. Its dense green scaling in conjunction with its dilated genæ and perfectly smooth elytra will sufficiently distinguish this species.

*34. Sciobius nanus, sp. nov. (Plate XIX. fig. 9.)

Long. $4\frac{2}{5}$, lat. $2\frac{3}{5}$ mm.

Head moderately transverse, convex, with sparse grey scaling which is denser round the eyes; forehead very finely striolate and without impressions; eyes convex but not prominent. *Rostrum* as long as broad, basal margin subtruncate, sides subparallel, genæ not dilated; upper surface plane, finely rugose and squamose, narrowly tricarinate, the outer carinæ with a slight outward curve in the apical half. *Antennæ* rather long and slender, piceous, with fine grey pubescence; scape narrow, cylindrical, evenly curved and gradually thickened to apex; funicle with the first and third joints equal. *Prothorax* strongly transverse, subcylindrical, truncate at base and apex, the latter scarcely narrower than the former, sides slightly rounded, broadest about middle; upper surface convex, finely coriaceous, and without lateral impressions, but with a shallow transverse impressed line close to apex; colour black, with grey scaling having a metallic greenish reflection. *Elytra* short, broadly ovate, truncate at base, sides strongly rounded, broadest before middle; upper surface convex, with fine striæ containing rows of shallow punctures; the intervals rather broad, of equal width, almost plane, finely alutaceous and entirely devoid of granules; colour black, with scattered traces of metallic green scaling. *Legs* moderate, piceous brown, with fine grey scaling and setæ; anterior tibiæ quite straight externally and scarcely curved internally.

Type ♀ in the South African Museum.

Cape Colony: Somerset East.

The unique specimen is a good deal rubbed, but it is probable that normally the scaling of the thorax and elytra is uniformly dense throughout. The species is closely related to *S. viridis*, but differs in its undilated genæ, more slender scape, and much shorter rotund elytra.

35. Sciobius prasinus, sp. nov. (Plate XIX. fig. 5.)

Long. 4–$4\frac{1}{2}$, lat. $1\frac{4}{5}$–2 mm.

Colour black, densely and uniformly covered throughout with greyish-green or bluish-green scaling.

Head transverse, slightly convex, coriaceous; forehead without any impressions; eyes rather prominent. *Rostrum* a little longer than broad, its basal margin sharply angulate, sides straight and parallel, genæ not at all dilated in either sex; upper surface plane and almost smooth, with only a faint central carina; the outer carinæ obsolescent and quite hidden beneath the dense scaling. *Antennæ* long and slender; scape not compressed, subcylindrical, slender, gently curved and abruptly clavate; funicle with the first and third joints subequal. *Prothorax* distinctly transverse, subcylindrical, base and apex of equal width and both truncate, sides very slightly rounded, broadest at middle; upper surface convex, evenly coriaceous throughout and without any impressions. *Elytra* ovate, truncate at base, shoulders very oblique, sides moderately rounded, broadest about middle; upper surface convex, with fine striæ which are found to be much broader and distinctly punctured when the scaling is removed, the intervals of about equal width, almost plane, quite smooth and impunctate. *Legs* rather long and slender, densely squamose, anterior tibiæ straight externally in ♀, greatly curved in ♂, first tarsal joint rather elongate.

TYPE, ♀ in the British Museum, ♂ in the Oxford Museum.

NATAL: Pinetown (*H. Junod*), Howick (*Dr. F. Dimock Brown*), Estcourt (*G. A. K. M.*)

From the two preceding small green-scaled species *prasinus* differs by reason of its more slender and abruptly clavate scape and its very elongate antennal club, by the obsolescence of the exterior rostral carinæ, and by its narrower and more acuminate elytra.

36. SCIOBIUS VITTATUS, sp. nov. (Plate XIX. fig. 8.)

Long. $5\frac{4}{5}$, lat. $2\frac{1}{5}$ mm.

Head strongly transverse, slightly convex, with close shallow punctuation and dense grey scaling; forehead not impressed; eyes slightly prominent. *Rostrum* scarcely longer than broad, arcuate at base, sides gradually convergent from base to apex, genæ not dilated; upper surface almost plane, tricarinate, with dense grey scaling except on the central carina, the outer carinæ straight but gradually diverging anteriorly. *Antennæ* moderately long and slender, piceous, with fine grey scaling; scape subcompressed, rather sharply curved and gradually thickened to apex; funicle with the first joint equal to the third, the subterminal ones rather short and distinctly clavate. *Prothorax* strongly transverse, base subtruncate, apex narrower and truncate sides slightly rounded, broadest about middle, with a shallow constriction at apex; upper surface convex, evenly coriaceous and without impressions, scaling dense uniform brownish grey. *Elytra* short ovate, jointly sinuate at base, sides strongly rounded, broadest at middle; upper surface very convex, with fine striæ containing small shallow and closely-set punctures; the intervals broad, almost plane, smooth and impunctate; colour black, with dense even scaling, the intervals being alternately grey and brown, the latter with a slightly brassy reflection. *Legs* moderate, piceous with fine grey scaling; the anterior tibiæ (♂) straight externally, but with the internal angle somewhat strongly produced.

TYPE ♂ in the British Museum.

TRANSVAAL.

Described from a single male received from Dr. W. Horn. This is a near ally of *S. viridis* Mshl., but apart from its very different colouring, it may be distinguished by its relatively shorter and broader elytra, more prominent eyes, undilated genæ and its broader and more sharply curved scape, as well as by the crenulation of the posterior tibiæ.

37. Sciobius arrowi, sp. nov. (Plate XIX. fig. 10.)

Long. $6\frac{2}{5}$, lat. $3\frac{3}{5}$ mm.

Head transverse, black, coriaceous, with dense brown scaling; forehead scarcely impressed; eyes moderately prominent. *Rostrum* distinctly longer than broad, sides subparallel, genæ scarcely dilated; upper surface deeply impressed, with three narrow carinæ, the outer pair parallel to near apex, thence divergent, very finely aciculate, and with dense brown scaling. *Antennæ* long and slender, piceous, with pale pubescence; scape strongly curved, slender, subcompressed and abruptly clavate; first joint of the funicle longer than the third. *Prothorax* rather broader than long, truncate at base and apex, the latter a little narrower than the former, sides slightly rounded, broadest about middle; upper surface convex, with depressed and rather distant granules, except along the central line which is smooth and coriaceous; colour black, the central portion almost bare, the sides with dense brown scaling which almost conceals the granules. *Elytra* broadly ovate, acuminate posteriorly, truncate at base, shoulders oblique, sides strongly rounded, broadest before middle; upper surface with the anterior portion of the disk quite flat, but rising posteriorly to beyond middle, the posterior declivity being much longer and more steep than usual, with fine striæ containing rows of shallow punctures separated by minute granules, the intervals almost plane, very finely aciculate, with a few scattered minute granules, mostly hidden by the scaling and more noticeable on the declivity; colour black with brown scaling on the disk, but paler towards the sides and apex, and with a conspicuous pale common **V**-shaped mark having its apex on the summit of the declivity, the intervals with distant pale setæ, which are longer and suberect on the disk, and shorter and depressed on the declivity. *Legs* slender, piceous, with uniform fine pale scaling, the anterior tibiæ slightly incurved at the apex.

Type in the British Museum.

Natal [coll. *Pascoe*].

I have seen only the type of this species, which was erroneously referred to *Phlyctinus callosus* Boh. by Pascoe. The shape of the elytra is unusual and gives the insect a distinctive facies. The specimen is probably a female.

38. Sciobius horni, sp. nov. (Plate XIX. fig. 11.)

Long. $7\frac{1}{2}$–8, lat. 3–$3\frac{1}{5}$ mm.

Head rather shorter than its width at base, black, with distinct close punctuation and fine grey pubescence, the impressed line dividing it from the rostrum very sharply angulate; eyes moderately prominent. *Rostrum* distinctly longer than broad, its sides subparallel, the genæ only slightly and roundly dilated in both sexes; upper surface slightly impressed, tricarinate, the carinæ straight and parallel, the punctuation and pubescence as on the head, the central carina bare and impunctate. *Antennæ* long and moderately slender, piceous and with fine grey pubescence; the scape not much curved, rather compressed and gradually clavate; the first joint of the funicle thickened, as long as the third. *Prothorax* rather transverse, gently rounded at the base, narrower and truncate at the apex, sides gradually dilated from base to beyond middle, thence rapidly narrowed to apex; upper surface convex, closely set with low rounded granules, but with a more or less distinct smooth central line; colour black, the granules bare, the interstices with fine grey pubescence which is denser at the sides. *Elytra* elongato-ovate, scarcely broader in the ♀, jointly sinuate at base and a little broader than the prothorax, shoulders very oblique, sides not much rounded, broadest about middle; upper surface convex, with distinct striæ, which appear to contain rows of deep punctures or rows of small distant granules according to the incidence of the light; the intervals convex, the first, third, and fifth more raised and rather narrower than the others, especially near the base, impunctate and without granules; colour black, with very fine short recumbent grey pubescence. *Legs* moderately long and slender, black with fine pale pubescence; the anterior tibiæ in the ♂ dilated internally in the middle and with a very deep sinuation near the apex, the first joint of the tarsi broad but scarcely as long as the next two together; the anterior tibiæ much less sinuate in the ♀.

TYPE, ♂ in the British Museum, ♀ in the Oxford Museum.

NATAL: Charlestown.

Nearly allied to *S. pollinosus* Fåhr., but it is a larger and narrower insect. It differs also in the deeper and closer punctuation of the head, the broader and more gradually dilated scape, the shorter third joint of the funicle, the slight elevation of the alternate intervals of the elytra, the greater sinuation of the anterior tibiæ in the ♂, and finally the first joint of the tarsus is less elongate.

The only three specimens which I have seen were kindly sent me by Dr. Walther Horn, of Berlin. Unfortunately they are evidently much rubbed, and probably in fresh examples the pubescence would bear some powdering similar to that of *pollinosus*.

39. SCIOBIUS WAHLBERGI Boh.

S. wahlbergi Boh. Schön. Gen. Curc. viii. Mantissa, p. 438 (1845).

Long. 6–8$\frac{1}{5}$, lat. 3–4 mm.

Head moderately transverse, black, with fine close punctuation, which is often more rugose near the eyes, and densely covered with metallic green scaling, there being usually three subdenuded lines corresponding with the rostral carinæ; forehead scarcely impressed; eyes not at all prominent. *Rostrum* distinctly longer than broad, its sides subparallel to beyond middle, the genæ only slightly and roundly dilated in both sexes; upper surface shallowly impressed, with three distinct narrow and evenly raised carinæ, the outer pair parallel to near apex and then curved outwardly; punctuation and scaling as on the head, but all three carinæ bare and impunctate, the apical emargination comparatively shallow. *Antennæ* long and moderately slender, piceous, with fine greenish-white setæ; scape scarcely compressed, distinctly curved and gradually thickened to apex; first joint of funicle much longer than third, subterminal joints longer than broad. *Prothorax* transverse, subtruncate at base, narrower and truncate at apex, sides slightly rounded, broadest about middle; upper surface convex, closely set with low granules, but with three broad smooth lines, the outer ones being oblique; colour black, the granules bare and shiny, the interstices with green scales which are denser on the smooth spaces. *Elytra* ovate, of the same shape in the two sexes, subacuminate towards apex, shoulders oblique, sides moderately rounded, broadest rather before middle; upper surface convex, with deep striæ containing large shallow punctures which vanish behind middle; the second, third, fourth, and seventh intervals strongly carinate, the carinæ being bare, shiny, and subcatenulate, the fifth and eighth intervals similarly carinate in the basal half and the sixth in its apical half, the remaining portions broad and smooth; colour black, the apices of the carinæ bare, the rest of the surface, including the striæ, densely covered with metallic pale green or yellowish-green scaling. *Legs* long and moderately slender, black, with dense greenish-white setiform scaling; the anterior tibiæ more curved apically in the ♂, but otherwise the legs are similar in the two sexes.

TYPE ♂ ♀ in the Stockholm Museum.

NATAL: Malvern (*C. N. Barker* & *G. A. K. M.*), Upper Tongaat R. (*C. N. Barker*), Howick (*Dr. F. Dimock Brown*), Karkloof (*Jas. Ball*), Drakensberg (*G. A. K. M.*).

A very distinct species on account of its brilliant colouring and carinate elytra.

40. SCIOBIUS SQUAMULOSUS Boh.

S. squamulosus Boh. op. cit. vii. 1, p. 194 (1843).

Long. ♂ 5, ♀ 6; lat. ♂ 2, ♀ 3 mm.

Head nearly as long as broad, slightly convex, finely punctured, and with dense greenish-grey scaling; forehead narrow and not impressed; eyes large and depressed. *Rostrum* elongate, basal margin arcuate or subangulate, parallel-sided in ♂, somewhat narrowed apically in ♀, genæ not dilated in either sex, apical emargination small; upper surface slightly convex, faintly tricarinate, the outer carinæ convergent anteriorly, scaling and punctuation as on the head. *Antennæ* long and slender, ferruginous, the apices of the joints infuscate, with fine grey scaling; scape cylindrical, strongly curved and abruptly clavate; funicle with the first joint about as long as the third, terminal joints subconical. *Prothorax* slightly transverse, truncate at base and apex, the latter distinctly narrower, sides gently rounded, broadest about middle; upper surface convex, finely and evenly coriaceous and without impressions, densely covered with greenish-grey scaling and with a white lateral stripe. *Elytra* ovate in ♀, much narrower in ♂, subtruncate at base, sides slightly rounded, broadest about middle; upper surface convex, with fine striæ containing close punctuation which is continued to apex; the intervals of about equal width, almost plane, quite smooth and shining; colour black, with dense even scaling, which is greyish or brownish with a dull golden-green reflection, the suture and extreme margins being whitish. *Legs* moderately stout, ferruginous or testaceous, with fine grey scaling, the anterior tibiæ straight externally in ♀, distinctly curved towards apex in the ♂.

TYPE ♂ ♀ in the Stockholm Museum.

CAPE COLONY: Grahamstown (*Miss Daly* & *Miss Sole*).

An aberrant species with no near allies. The depressed and approximated eyes in conjunction with the comparatively narrow and elongate rostrum will at once distinguish it; but these characters scarcely justify the creation of yet another monotypic genus. Boheman states that the rostrum of the ♂ is not carinate, but this is incorrect, for the carinæ are present in a specimen captured by Drège which I have examined, although less distinct than in the ♀.

Doubtful Species.

41. SCIOBIUS PAIVANUS Woll.

S. paivanus Woll. Ann. Nat. Hist. (3) ix. 1862, p. 22.

"*S. ovatus, nigro-fuscus sed squamulis parvis demissis albidis parce nebulosus, rostro utrinque carinato; prothorace brevi, subconico; elytris profunde punctato-striatis setisque erectis rigidis obsitis, obscure albido-tessellatis; antennis, tibiis tarsisque fusco-ferrugineis.*

"*Long. corp. lin.* $2\frac{2}{3}$.

"Habitat 'ad varias leguminas spinosas regionis littoralis.'—Dom Welwitsch."

I have been quite unable to identify this species, nor do I know where the type is to be found. Mr. Arrow has kindly searched through the Wollaston types in the British Museum, and informs me that *S. paivanus* is certainly not among them. It is impossible to say for certain from the description only whether the species really does, or does not, belong to the genus *Sciobius*. The absence of the central rostral carina and the presence of erect, stiff bristles on the elytra are both aberrant characters. But it is the locality (Angola) which makes the point specially doubtful, seeing that all the other species of the genus are confined to extra-tropical S.E. Africa. Moreover, Wollaston was probably not quite clear as to the distinctive characters of *Sciobius*, as the other species described by him proves to be a *Phlyctinus*. It appears likely, therefore, that *paivanus*, when rediscovered, will be found to belong to *Systates* or some other allied genus.

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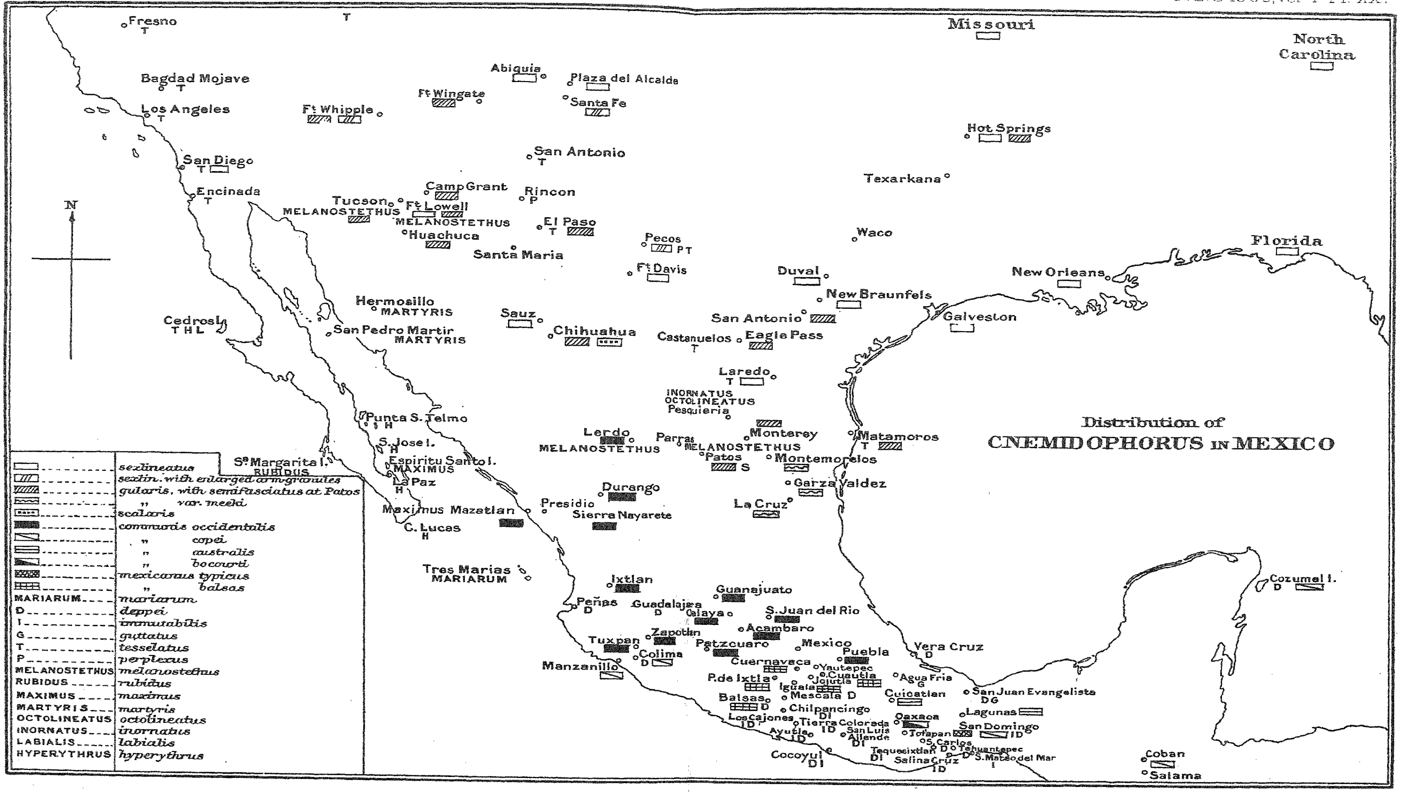

Distribution of CNEMIDOPHORUS IN MEXICO

Bale & Danielsson, Ltd.

3. A Contribution to the Study of Evolution based upon the Mexican Species of *Cnemidophorus*. By Hans Gadow, F.R.S., F.Z.S.

[Received March 2, 1906.]

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It was in the forest and bush region of the Atlantic Tierra caliente, on the confines of the States of Oaxaca and Vera Cruz, that I first became personally acquainted with *Cnemidophorus*. There was only the spotted, large *C. guttatus*, but further east, where the Savannah begins, its place was taken by the small, striped *C. deppei*.

On the Pacific side of the Isthmus, at Tehuantepec and Salina Cruz, was *C. deppei* and the large, conspicuously striped *C. immutabilis*. These kept on further inland until near the foot of the abrupt southern edge of the plateau. The small *C. deppei* ceased, and a very large, tiger-barred lizard, *C. mexicanus*, made its appearance. The striped *C. immutabilis* seemed to continue, but on closer examination it was found that all the striped mid-sized to large specimens were the young and immature of *C. mexicanus*, which reigned supreme on the open southern plateau until at Oaxaca itself it was joined by the spotted, rather brightly coloured *C. bocourti*. Thus the *Cnemidophorus*-fauna showed a very different aspect in the east, south, and north-west of the triangle examined during my first journey.

On the second journey, chiefly in the States of Morelos and Guerrero, the aspect was again different. There are no *Cnemidophori* in the Valley of Mexico. They were not met with until I had crossed the high range of mountains which separate the Central plateau from Morelos. The only *Cnemidophori* at Cuernavaca were the partly striped, partly marbled or slightly cross-barred variation of *C. mexicanus*, var. *balsas*, and such specimens were traced southwards to the River Balsas and up again to Chilpancingo in Mid-Guerrero. In the hot valley of the Balsas itself it associated with *C. deppei*, which was, however, rather differently coloured from any of those met with in Oaxaca; it disappeared long before the backbone of the Sierra Madre del Sur upon which Chilpancingo lies; but on descending the southern slope, the upper limit of the Tierra caliente was marked by the reappearance of *C. deppei*, and by a larger striped form which recalled *C. immutabilis*, and any doubt about this was set at rest at a still lower level, where these two kinds persisted down to the Pacific coast.

All this was sufficient to rouse my interest, and I did not miss many opportunities of at least trying to secure as many of these lizards as possible. It was not easy. Only at a few places did I receive real help from the Indians. In 1902 I caught the lizards by hand, with nooses or with whips, a procedure which often reduced my party to utter exhaustion. Shooting with a pea-rifle was naturally not very successful. In 1904 I took Dr. Meek's hint and provided myself with a small pistol and shot-cartridges, and thus I secured hundreds of creatures which otherwise would have escaped. Still, even this was hard and uncertain work. When, as in Guerrero, during the rainy season a dense mass of herbs springs up almost everywhere, no ground-lizard can be seen except in the narrow tracks across which they flit, to hide in the tangle, warned by our approach. Moreover, they are very local and they do not always appear. Rain, certain winds, or a dull sky keep them in their lairs. One may ride for days and not see a single specimen. Then suddenly there may be hundreds, and what are really members of one clan or even of a smaller family may be collected. The next few days again may yield nothing or only a single specimen here and there; and this is really worse than nothing, since it leaves it undecided whether its characters are truly typical of that district, or merely individual.

We collected in the States of Oaxaca, Morelos, and Guerrero some 250 specimens. An enforced prolonged stay in the hospitable house of Professor Whitman in Chicago enabled me to examine about 200 specimens in the Field Museum of Nat. Hist., mostly collected by Dr. Meek in regions which I have not visited myself, but about which he could give me valuable information as to the physical features. I have to thank the authorities of that splendid museum for their liberality in sending over to Cambridge the greater number of their *Cnemidophori* for minute examination. These were supplemented by the study of the specimens in the British Museum, where, as usual, I had the inestimable benefit of my friend Boulenger's critical advice and never-failing help. Some Berlin types have also been examined.

The total of *Cnemidophori* studied for the purpose of this paper amounts to some 520 specimens, from the United States to the Isthmus of Tehuantepec; about 450 of these are detailed in the appended tables. Adding about 40 from South America in the British Museum, studied cursorily for general comparison, the whole amounts to some 560 specimens, apparently sufficient for all purposes, but in reality not so, since, for instance, the whole *tessellatus*-group is but meagrely represented. The whole range, from the Isthmus to Utah, is enormous, more than 2000 miles; and even if we restrict ourselves to Mexico, the 500 specimens are crowded into comparatively few districts and leave many large regions blank. Such a blank is, for instance, the country from Colima to Acapulco, 300 miles. For the whole of Mexico proper, excluding Yucatan and Lower California, scarcely 60 localities are on safe record. A single locality, Hermosillo, represents the whole large State of Sonora, and Presidio near Mazatlan the State of Sinaloa.

Mexico is an ideal country for the study of geographical distribution, because it contains, often in juxtaposition, vast semi-deserts, high plateaus, big continuous ranges of mountains with peaks in the eternal snow, hot lowlands of the Atlantic or humid type with luxurious rain forests, and of the Pacific or drier type; large forests of pines, oaks, or of tropical trees; rivers and lakes; regions of enormous fertility and hopeless deserts. In short, every climate and every conceivable kind of bionomic conditions are represented in this country. No wonder that this diversity is expressed in the well-nigh endless, kaleidoscopic variations of the genus *Cnemidophorus*, the main genus of strictly humivagous Lizards of the country.

This Tejid genus is invaluable for the study of variation. It is so plastic within its well-defined generic characters, that it is represented by some form or other in almost every kind of terrain. Its highest altitude above sea-level seems to be reached near 7000 feet, as shown by its occurrence near Santa Fé in New Mexico. In Mexico its highest record is 7100 feet near Puebla; it is absent in the Valley of Mexico, about 7400, and at Amecameca 8000 feet, but it reappears at San Juan del Rio 6300, Celaya 5800, Acambaro 6000, Patzcuaro 6700, Durango 6200, Chihuahua 4700 feet. These localities show that the lizards are not averse to moderate altitudes, but all these places are situated on some kind of plateau. On more isolated mountains the lizards seem to stop at a lower level. For instance, on the eastern slopes of the Nevado de Colima they stop at 5100, on the Cerro de San Felipe near

Oaxaca at 5400, whilst they are swarming at 5200 feet level. Near Chilpancingo they do not go beyond 4500 feet. I suspect that they are stopped by those changes which on so many mountains coincide with the usual lowest level of the clouds.

Although frequently found in ravines and on the spurs of mountain-ranges, they avoid the mountains themselves, and above all they are averse to crossing a system of cut-up ridges even of moderate height.

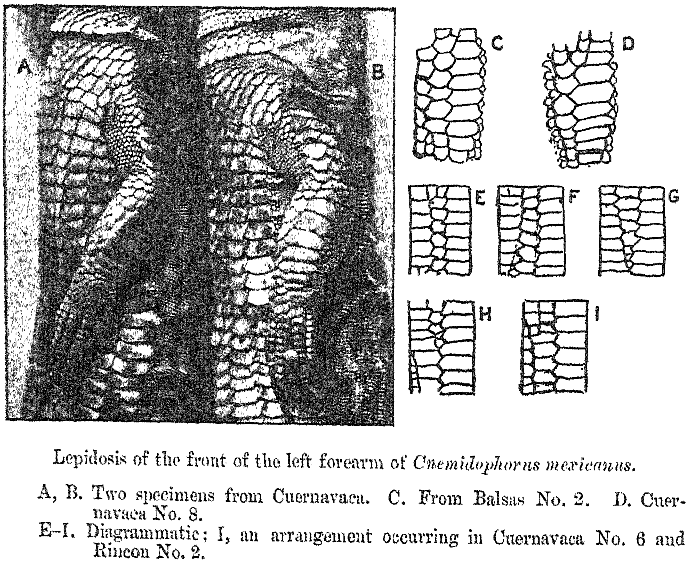
Some species, *C. deppei*, *immutabilis*, and *guttatus*, are natives of the Tierra caliente, which they do not leave, so that any continuous rise beyond 3000 feet is to them an absolute barrier. When, by the way, Cope mentions *C. deppei* from Guadalajara, this certainly cannot refer to the plain of 5000 feet upon which this town lies, but to the deep depression of the neighbouring Rio de Santiago, 2000 and more feet lower!

Southern, tropical species do not ascend far; but northerners, or let us say highlanders, extend their range frequently into the lower, tropical climes, and thereby they undergo considerable changes.

It was stated that these lizards are very plastic. There are some species which average only 50 mm., while others reach a nose to vent length of 140 mm.

I have selected only a few characters, chiefly the supraoculars, the composition of the collar, the rows of scales of the humerus,

Text-fig. 61.



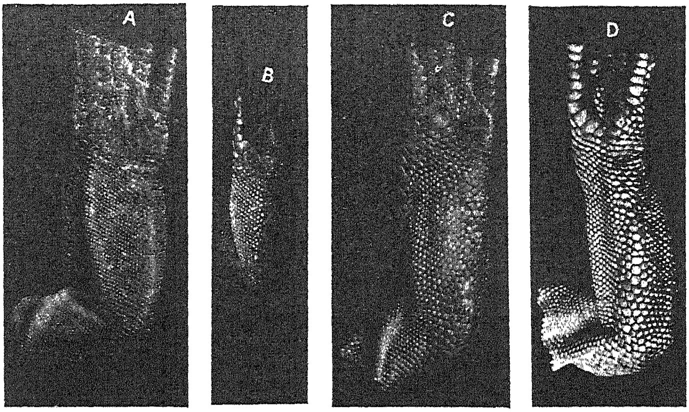
Lepidosis of the front of the left forearm of *Cnemidophorus mexicanus*.

A, B. Two specimens from Cuernavaca. C. From Balsas No. 2. D. Cuernavaca No. 8.

E–I. Diagrammatic; I, an arrangement occurring in Cuernavaca No. 6 and Rincon No. 2.

the fore and hind aspect of the forearm, thigh and tibia, the femoral pores and the coloration, or rather the pattern and its modes of evolution as indicated in the various kinds from youth to age. These characters are not all of equal importance. The scaling in front of the forearm and of the tibia is subject to endless individual variation in detail, even in specimens from the same locality, so much so that these variations cannot be well described in short terms. For instance (text-fig. 61), on the front of the forearm there may be 3 longitudinal rows of transverse scales, or only 2½ rows, *i. e.* two complete and a shorter, smaller row intercalated from the elbow downwards; or the half row may be added to the side. The sole object is to protect a given surface with scutes, and this is attained in various ways. If some scutes happen to be larger than usual, others are correspondingly reduced; and if there should not be room enough for all the preformed scutes to grow, granules fill up the spaces, the total available space being of course predetermined, *cf.* text-fig. 61.

Text-fig. 62.



Lepidosis of the under surface of the left forearm.

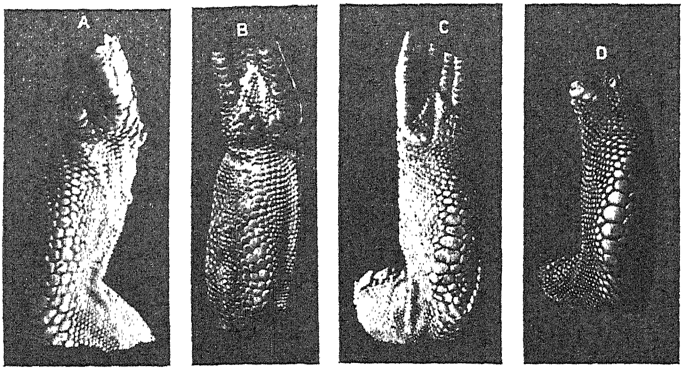
A = *C. immutabilis*, Salina Cruz No. 1. Covered entirely with small granules.
B = *C. sexlineatus*, North Carolina. Covered with enlarged granules.
C = *C. australis*, Laguna, Oaxaca. With slightly enlarged granules.
D = *C. australis*, Laguna, Oaxaca. With enlarged granules.

The rows of scales or scutes which cover the thigh (counting from the pores to the highest row on the front aspect of the thigh) are often difficult to count, especially when some of the rows are not arranged in regular lines. Frequently some scutes are intercalated, representing what in other specimens has been developed into an entire extra row. There are many indications that the number of scales, or of the rows, increases with the size, with the growth of the lizard, and still more likely with the growth of the species.

This question must be left in abeyance. As a rule, however, the larger species seem to have more numerous scales upon the thighs and elewhere than their nearest smaller relations. This may be in the nature of things; it is quite possible that these many-jointed armourings cease to fulfil their purpose when the individual components pass beyond a certain size.

The presence or absence of a separate frenocular plate, so often relied upon in systematic works, is quite unreliable. Its absence is due equally often to suppression as it is to fusion with some neighbouring plate.

Text-fig. 63.



Lepidosis of the under surface of the forearm.

A = *C. mexicanus*, Balsas No. 3. Right forearm. Several rows of enlarged polygones down to wrist.
B = *C. mexicanus*, Balsas No. 2. Right forearm.
C = *C. mexicanus*, Cuernavaca No. 8. Left forearm. Large scutes.
D = *C. mexicanus*, Cuernavaca No. 10. Left forearm. Large scutes.

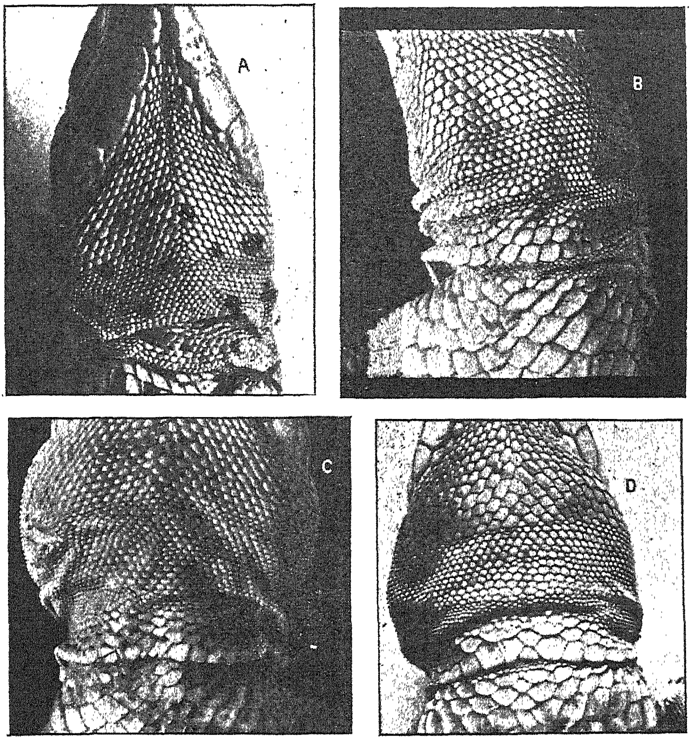
It seems reasonable to assume that 4 supraoculars represent the more primitive condition, whence, by reduction of either the anterior or the posterior scute, the number is reduced to 3. In most of the text-figs. 61–83 these features are clearly visible.

The composition of the collar and the protection of the posterior side of the forearm are difficult to describe in a few words. To avoid the drawback of vague terms, the reader is referred to a series of illustrations which are intended to standardise the phraseology employed in this paper (text-figs. 62, 63, 64, 65).

Some systematists have laid stress upon other characters. Peters, for instance, found that the first upper labial was denticulated in *C. deppei*; this is best seen on the inside, but it is by no means always the case in that species, while it occurs also, occasionally, in *C. immutabilis*, in *C. communis* from Cozumel Island, and perhaps in others.

Unpracticable were also the, at first sight, great differences whether the keel of the tail-scales runs parallel, subparallel, or oblique to their main axis. Cope and others have employed the relative length of the hind limb as expressed by the point which the longest adpressed toe reaches on the neck, ear, or eye. This criterion had to be discarded on account of astonishing variation in allied individuals.

Text-fig. 64.



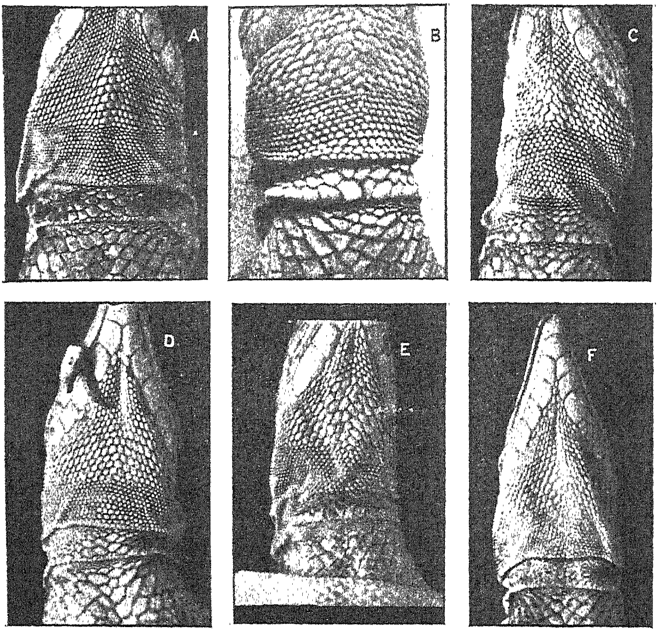
Lepidosis of the collar and throat.

A = *C. tessellatus* from El Paso, Field Columb. Mus. Collar composed entirely of small, mostly granular scales.
B = *C. mexicanus*, from Totolapan No. 2.
C = *C. communis australis*, Cuicatlan, 140 mm.
D = *C. communis australis*, Laguna. Collar composed entirely of large scales.

The skin of the back is granular, but the grains may be fine or coarse; there is no way of expressing this intelligibly; moreover, counting of the grains across the middle of the body reveals enormous individual differences—for instance, in *C. guttatus* of Aqua fria from 100–180 granules across.

The arrangement of the scaling of the preanal region proved likewise unmanageable. It does not follow that these discarded characters are of no systematic value. On the contrary, the sum total of these and of many others produces that general something which so often tells the experienced what kind of lizard he has got hold of, before submitting it to his artificial keys, which in really interesting cases often refuse to work.

Text-fig. 65.



Lepidosis of the collar and throat.

A=*C. immutabilis*, Salina Cruz No. 1. Edge of collar formed by a complete row of granules. A nest or cluster of enlarged granules in the centre of the throat.
B=*C. mexicanus*, var. *balsas* No. 8. Collar composed entirely of very large scales.
C=*C. deppei* from San Carlos. A few single granules intercalated between the large scales forming the edge of the collar.
D=*C. sexlineatus* from North Carolina.
E=*C. deppei*, Cocoyul No. 5.
F=*C. communis australis*, Cuicatlan, half-grown. Collar composed of very small scales and many granules.

Supraoculars + Collar + Humerus + Forearm + Femur
+ Pores + Coloration = Species,

is a kind of condensed equation, but the line has to be drawn at its length, lest the equation becomes bewildering when comparing the variations of many kinds with each other. Since each of these characters may have at least two values (large or small in numbers or in size as the case may be), the possible number of permutations is enormous, at least theoretically, but in reality it comes to pass, that, owing to some occult law of correlation, certain combinations do not occur. These give us a clue as to the specific, subspecific, &c. value of the items employed. For instance, in the whole genus of *Cnemidophorus* the *a priori* obvious combination of large posterior arm-scutes with only 3 supraoculars does not occur, except as individual freaks or true abnormalities. A well-scutellated forearm is mostly associated with a large-scaled collar and with 4 supraoculars, perhaps because the prevailing bionomic conditions favour a strong lepidosis; but where the *genius loci* favours small scales, the completely granular forearm is coupled with a small-scaled collar (*e. g.* in the *tessellatus*-group, text-fig. 64 A); or the collar is in an unstable condition, the scales decreasing in size towards the sides of the collar and interspersed granules are frequent on the edge (*e. g.*, in *C. deppei*, *C. sexlineatus*, and *C. communis australis*, text-fig. 65 D, E). It is then a question which part initiates the change, and which parts follow suit, or, may be, are not allowed to yield to the new tendency. For "not allowed" we may say "overruled by natural selection."

Unfortunately we know next to nothing about the advantages of these features. Broadly speaking, large forearm-scutes are a feature of the high plateau and of the mountainous districts, but not of forests, grassland, or sandy soil. I rather suspect that arm-scutes are connected with a rough ground, physically rough in its detail composition, such as is produced by the rubble of volcanic and limestone formations. The same agency may be applicable to the collar, but not conceivably to the supraoculars.

Concerning the *colour pattern*. A spotted garb, light spots upon darker, uniform ground-colour, seems to be the effect of forest or bush life upon an originally striped creature; for instance, *C. immutabilis* compared with *C. guttatus*, and *C. bocourti* with *C. mexicanus*; but it is also the reaction of a life on the open, periodically droughty plateau, *e. g.* the strongly spotted *C. communis*. This seems contradictory, but the *tertium comparationis*, the moving agency is the monotonous light, whether this be due to the abundance of broken shade, the subdued light in the forest, or the absence of shade in the open under a glaring sky. In neither case can the organism retain the stripes! Moreover, that unknown influence which causes the appearance of pale field spots has thereby introduced a new element, witness the behaviour of these spots during their growth so that a longitudinally striped pattern may be converted into one of transverse stripes. However, these questions have been dealt with, tentatively at least, in Proc. R. S. 1903.

The so-called systematist wants above all to label and shelve his specimens; his beau ideal is a good species, and his ambition as many of them as possible. His chief anxiety is to point out the differential characters. Every individual belongs, in his idea, to a perfectly definable assembly, the ultimate boundaries of which enclose the "species." There are also others, not "splitters," but "lumpers," who, rightly allowing more amplitude of variation in their conception of a species, commit the following error. They think that intergrading of two species is the same as continuity from one extreme to the other. For instance, if the overlap of all the available characters should occur in one and the same specimen, then presumably the two supposed species would be the same, but not—and this is the usual procedure—if the overlap of the characters occurs only in a whole number of specimens taken together.

The following diagram illustrates an important point. Let *a*, *b*, *c*, *d* be 4 different characters, each of which can vary from, let us say, small to large; and let us assume that character *a* (for example the scutellation of the forearm) is the quickest, the most susceptible, to change. Let species A change towards B, and let B change towards A, by gradually assuming the respective characters. Then it will be found that the two changing series will overlap completely or coincide in all their four characters, only when all these characters have arrived at a medium condition, and again when they all have arrived at the other extreme end. The diagram shows moreover that, although the results are the same, at the terminus and in the middle, the A and B series of evolution are different at every stage.

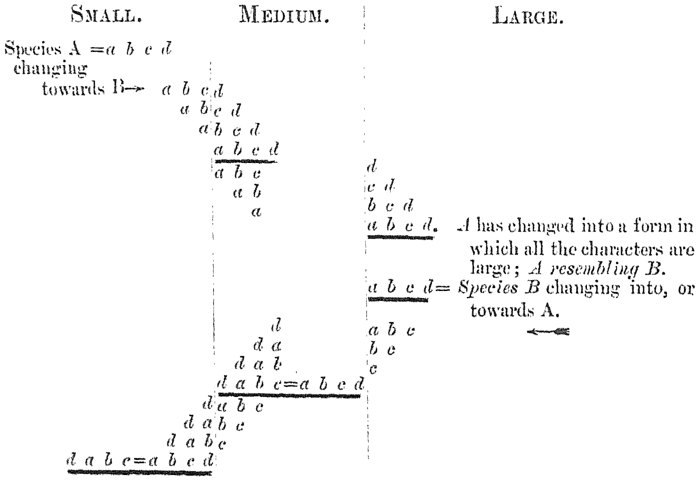

SMALL.
MEDIUM.
LARGE.
Species A = a b c d changing towards B →
a b c d
a b c d
a b c d
a b c d
a b c
a b
a
d
c d
b c d
a b c d.
A has changed into a form in which all the characters are large; A resembling B.
a b c d = Species B changing into, or towards A.
a b c
b c
c
d
d a
d a b
d a b c = a b c d
d a b c
d a b c
d a b c
d a b c = a b c d

Diagram illustrating the overlapping of characters.

Species B resembles A, but is not genetically the same, since the combinations *d a b* small, or *a b c* medium and *d* small, &c. occur nowhere in the series which represents the changes from *A* towards *B*.

In this paper I have employed a great number of specific &c. names, often using trinomials, in fact as many as the greatest of "splitters"; but this has been done for the sake of convenience, for shortness of expression, and having done my best to diagnose the groups, species, subspecies, races and varieties, I have proceeded to point out those individuals which upset the diagnoses.

Cope has rightly said, Report U.S. Nat. Mus. for 1898 (1900) p. 569:—"The discrimination of the North American species of this genus is the most difficult problem in our herpetology. Nowhere are subspecies more sharply defined than in *Cnemidophorus*, that is geographical forms, which are not always true to their characters." He, however, practically left the Mexicans untouched, confining himself to those of the United States.

Most of the "species" are so plastic, so variable, that they may well drive the systematist to despair. Not two authorities will, nor can, possibly agree upon the number of admissible species.

The *Cnemidophori* in their unsettled condition, are truly delightful as an ideal object lesson in Nature's way of species-making.

It has been my ambition to find truly intermediate individuals, real links between the groups and between the reasonably supposed species. This was suprisingly difficult! It was a reasonable premiss that such links should occur at the same place, at least in the same district, with the two forms to be linked. If the link occurs somewhere else, the question enters a new field of inquiry.

It is fairly certain that the three forms of the *deppei*-group, *C. deppei*, *C. immutabilis*, and *C. guttatus*, are closely allied to each other; and it may now be taken as proven that *C. immutabilis* turns into *C. guttatus* in consequence of living in the Atlantic Tierra caliente. These two forms actually run into each other, but they are easily separable when in their respective typical garbs, in which case, moreover, slight structural differences are apparent. Result: C. guttatus *is a terminus of evolution, as being the spotted race of* C. immutabilis—scientifically expressed, *C. immutabilis*, var. *guttata*; but thanks to accident, priority of naming, it has to stand as *C. guttatus guttatus*, and the parental stock form stands as *C. guttatus*, var. *immutabilis*! No sense in that, but justice is done to the fetish, although not to the lizards to which these paraphernalia should be subservient.

Further, the Salina Cruz, Tequesixtlan, &c., specimens of Oaxaca are typical, intensified *C. immutabilis*; they can hold no intercourse with those of the Atlantic side, a point about which I am positive, owing to the configuration of the country. Mingling still occurs on the isthmus proper; and in the forest-lands of Guerrero *C. immutabilis* tends to assume the spotted garb. Now let us assume that these woods were destroyed for ever, and that the divide between the Atlantic and Pacific hot-lands is also laid bare, then we should have the typical *C. guttatus* in the Atlantic Tierra caliente, and the typical *C. immutabilis* on the Pacific coast: two good species, because they are well defined and geographically separated. They were considered as good species by Cope and by Boulenger; but I found the intermediate forms in districts of intermediate bionomic conditions, so that now at best they are subspecies, if not local races, or, worse still, only pattern-varieties.

In short, we have here two forms in the actual process of evolution, which require only the accident of a physical separation belt—which of course would not alter the remaining individuals—to give them the standing of local races, but scarcely of subspecies on account of the slight structural differences, and this because they are still in the process of making!

It is fairly safe to consider the var. *immutabilis* as closely allied to *C. deppei*, perhaps as a larger form evolved from a more generalised clan of *C. deppei*. On p. 319 the question is discussed whether true links still exist between them, but none have been found. It is therefore concluded that *C. deppei* and *C. immutabilis* being practically coterminous in their wide range, their differentiation from the hypothetical common stock had proceeded far enough to turn them into "species," implying the disappearance of links. In other words, these two forms, concerning each other, are no longer in the act of being made *. This may mean either that their divergence dates back a longer time, or that they have divided the ground between them sufficiently well, leading lives too different for competition, and too diverse in the ensuing reaction upon the surroundings, so that the differentiation has proceeded more rapidly. The facts that *C. deppei* inhabits also the Atlantic hotlands, where it meets the *C. guttatus* (from which it is structurally and in pattern more widely removed than from the *C. immutabilis*), and further, that *C. deppei* has such an enormous range southwards into South America, these circumstances rather favour the assumption that *C. deppei* is an old form and that the evolution of *C. immutabilis* is of an older date than its splitting into the present striped and spotted or Pacific and Atlantic races. *Present species are older than subspecies, and these are older than their present races.*

On p. 305 the very pertinent question is discussed whether the small *C. deppei* is always separable from the equally small *C. sexlineatus*, the least differentiated, the most primitive of the whole genus, of which, by a fortunate accident, it happens to be the type. We there succeeded in singling out some specimens of *C. sexlineatus* from Sauz near Chihuahua, and of *C. deppei* from South Guerrero, which apparently are not separable; but we had to explain these as cases of convergent development, or, let us say, as due to the coincidence of the variations of all the characters employed. Some valid reasons were given to show that these Guerrero clans are local varieties of the other surrounding *C. deppei*. The argumentation seems satisfactory, but it would have been far less so, if these convergent lizards had been taken in neighbouring districts, instead of 1200 miles asunder. *C. deppei* and *C. sexlineatus*, with regard to each other, are two good species in the fullest sense, although all their available characters may overlap, or intergrade, not only singly, but conjointly. They are two old species, sprung from one common stock, well and firmly established, representing each other in widely separate and apparently very different countries, one in the Tropics, the other in North America proper. Florida and Texas have much of the type of the Tierra caliente, but it would be hopeless to look for the *tertium comparationis* between the more Northern States and the Tropics of Mexico and Central America, unless we assume that the North-western Plateau, with its ranges of mountains, from the Western States right through Mexico, has caused the evolution of the many other kinds of Cnemidophori, which now separate and connect *C. deppei* and *C. sexlineatus* *.

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* The differences are, however, sometimes so small that, if, for instance, the Cajones (text-fig. 81 E) or the Miahuichan specimens (*cf.* p. 326) were the only representatives known of *C. immutabilis*, we should unhesitatingly treat them as a subspecies of *C. deppei*!

Our problem is not to explain why these two species should occasionally be so much alike each other in their widely different habitats, but to investigate whether, how, and why the intervening country, the bulk of Mexico, has turned its lizards into what they are, namely the great *gularis*-group.

The family of the Tejidæ is old. Of several dozen so-called genera in South America, only two are found also in Mexico; namely, one species of *Ameiva* in the eastern and western hot-lands, and the genus *Cnemidophorus* incl. *Verticaria*. This genus is old, but not old enough to occur on the West Indian Islands, a fact which limits it to the end of the Miocene epoch. Yucatan was under water until the beginning of the Pliocene; it has received its few *Cnemidophori* since that epoch, and the same applies to the Atlantic lowlands along the Gulf to Florida. Only *C. guttatus* and *C. deppei* have got into these parts of Mexico. For Texas only *C. sexlineatus* and the little *C. gularis* were available immigrants.

C. mexicanus, a very distinct species, exists on the Tres Marias Islands. Other species inhabit the small islands of Lower California, both in the Gulf and to the west of the peninsula; proofs of the existence of the genus in Mexico in early Pliocene times.

It is doubtful when the great central plateau between the Eastern and Western Sierras Madres became dry land; until late Tertiary times it was an inland lake. Longest available for terrestial creatures were Southern Mexico and the Pacific portion—a great stretch of land from Central America to California, including parts of the present Pacific Ocean. It is in this belt that we have to look for the home of the Mexican and North-American *Cnemidophori*. Their present distribution agrees well with this hypothesis. There is an abundance of species in the South and in the North-west, whilst towards the North and East, across the plateau, occur far fewer forms.

The great *TESSELLATUS*-group is an illustration of a group centred in the North-west, whence it has sent a few outlying forms eastwards through the basin of the Rio Grande. The *GULARIS*-group is strong along the Western Sierra. *C. gularis* itself is the only kind which follows the same basin, and it is (with the exception of some *tessellatus*-forms near Monterey) the only species known in Nuevo Leon and Tamaulipas. *C. communis* extends from Jalisco

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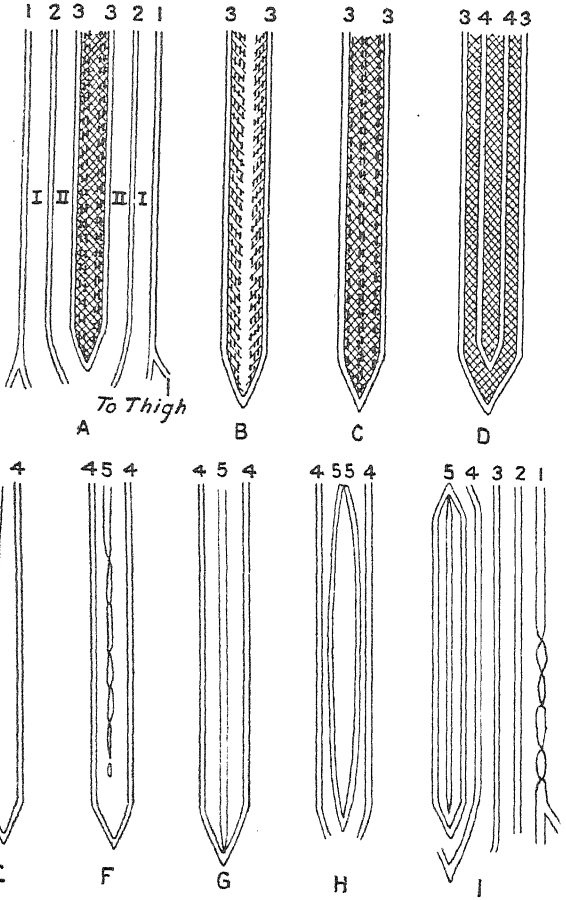
* Lack of material has prevented me from corroborating Cope's statement that *C. sexlineatus* and *C. gularis* absolutely merge into each other, *cf.* p. 305.

Text-fig. 66.*



Evolution of Pattern of *C. deppei*, from 6 to 11 pale stripes.

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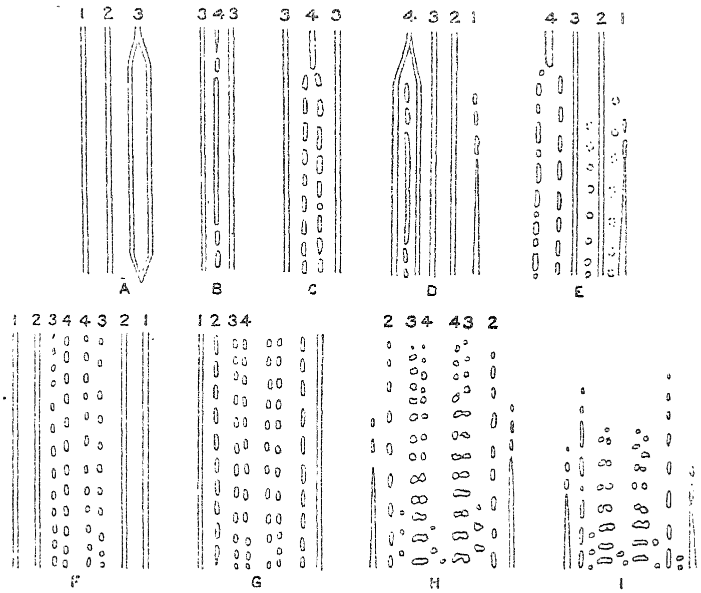
* *In all these diagrams of pattern evolution the Arabic refer to the white* stripes *or their subsequent changes. The Roman numerals refer to the* Fields. *Field I lies between stripes 1 and 2, Field II between stripes 2 and 3.—Stripe 1 passes through the Ear, along the flank and upon the Thigh. Stripe 2 passes through the Eye, above the Hip and upon the Tail. Stripe 3 encloses the* mid-field *when there is no fourth pair of stripes.*

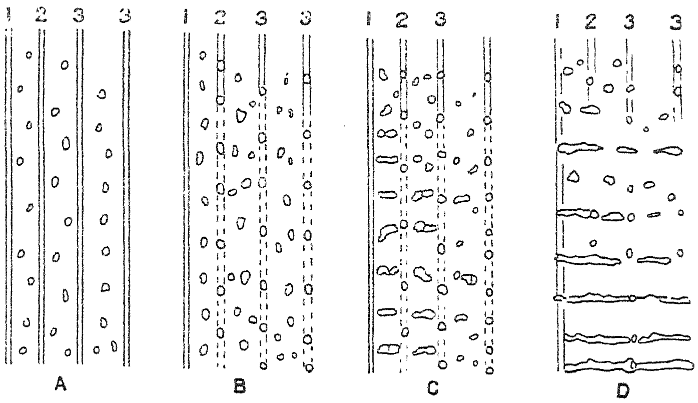
across Guanajuato to Puebla, and in Southern Mexico, below the plateau, we find an abundance of various kinds.

Text-fig. 67.



Evolution of Pattern of *C. immutabilis* A to E, and of *C. guttatus* from youth F to old age I.

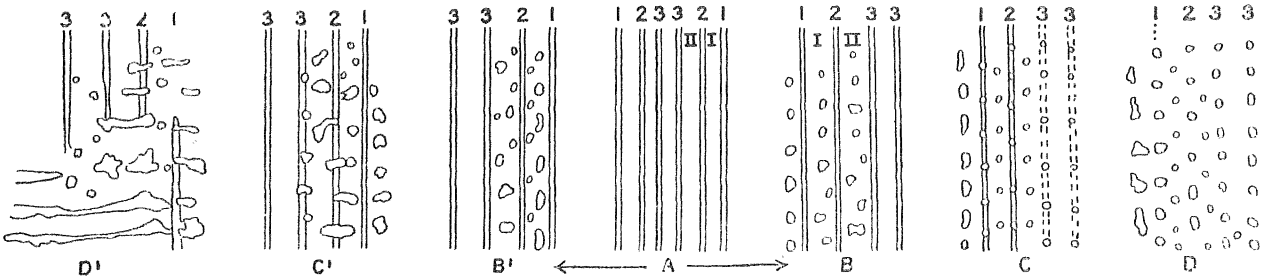
Text-fig. 68.



Evolution of Pattern of *C. scalaris* from youth to adult; cf. text-fig. 76, p. 336.

There is a great gap in the map without any *Cnemidophorus*,

Text-fig. 69.

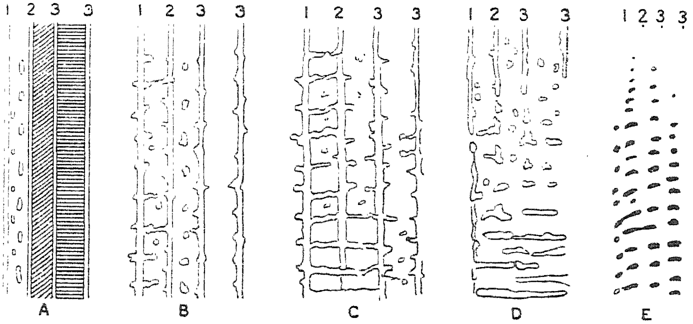


Evolution of Pattern of *C. communis* from A to D and of *C. mexicanus* from A to D¹.

A represents the actual youthful stage of *C. gularis*, *C. communis*, and *C. mexicanus*.
B and B¹ represent the actual adult stage of *C. gularis*, the immature or transient stage of *C. communis* and *C. mexicanus*.

roughly speaking within a triangle from Tampico and Vera Cruz to Zacatecas. Most of the latter State lies too high; and this altitude would be a sufficient factor for stopping the eastward extension of *C. communis* and its allies. No *Cnemidophori* have ever been recorded from Jalapa, although that district has been the hunting-ground of many good collectors; none are known from Orizaba district, and the Comision cientifica (*cf.* Cope's List, Proc. Am. Phil. Soc. 1885, p. 372) returned none from the State of Hidalgo. The northern half of the State of Vera Cruz is covered mostly with rain-forest. The reputed absence in the triangle is easiest accounted for by the assumption that *C. gularis* coming from the North, and *C. deppei* with *C. guttatus* from the South, have not yet met, perhaps cannot meet on account of unsuitable bionomic conditions.

Text-fig. 70.



Evolution of Pattern of *C. tessellatus* A–D and of *C. rubidus* E.

How, then, have we to imagine that the spreading of *Cnemidophorus* in Mexico has taken place? Of course we leave aside the idea of a multiple origin. The usual explanation of zoogeographers would be as follows:—Some indifferent species spreading from the South through the Pacific half of the country northwards, and thence into the United States, has on its way given rise to the various forms of lizards. This not unreasonable assumption, if applied to the species as we actually find them distributed, would imply that they have changed, say, from *A* into *B* into . . . *E*, each with side-branches or sub-species, but that on their arrival in the North in the form *E* they have been turned again into something like *A*. *Deppei* and *sexlineatus* are near allies, but such a reversion or return to pristine conditions is most unlikely. It would, moreover, mean that *E*, while assuming *A*-like characters, must also be rather like *B*. But in reality this is not the case. On the contrary, *A* (*sexlineatus*) turns into *E* (*gularis*); this in turn into *D* and *C* (*communis occidentalis*); *C* into *B* (*C. copei*), the var. *australis* of which we have some occasional difficulty in separating from *C. immutabilis* and *guttatus*, which are very different from *C. sexlineatus*. *C.* in another direction, turns in Michoacan and the Balsas basin into *C. mexicanus*, which reaches its terminal development in Oaxaca. Lastly, *C. bocourti* represents a third offshoot from *C. communis* (cf. p. 287 and pp. 356–358).

We have therefore to search for another explanation. We postulate the existence of an indifferent stock, somewhat like a combination of *C. deppei* and *C. sexlineatus*, with a range from South to North over those parts of the country which at that unknown period did not yet exhibit the present variety of physical, bionomic features. Certainly the Western Sierra was there in bulk, but not as it is now. Then came the physical changes: subsidence of much of the Pacific land; the development of desert features in the North-west and North; the transformation of the central lake into a silted-up plain, the central tableland; the spreading of forests over the Sierra after the volcanic eruptions had subsided,—in short, the assumption of the more recent features of Mexico.

Hand in hand with these changes went the making of the species, *in loco*; and as they spread further upon new ground, they changed further, giving rise to still newer varieties, races, subspecies, and species, a seemingly endless kaleidoscopic process. This is not a new process; it was always going on, but we see only the present results, and of the many extinct forms we know naught.

Broadly speaking, there are now three or four main groups. One centres round *C. tessellatus*, essentially in the North-west and North; a second comprises the *gularis*-group of the Centre and West; thirdly, the essentially Southern, tropical *deppei-immutabilis* group; lastly, *C. sexlineatus*, the least specialised, in the United States. Each of the four geographical regions or main habitats of these groups has its own characteristic features; they are types of bionomic conditions.

The greatest number of well-distinguished forms occurs in the Lower Californian district. At least 6 (or 7 with *C. sexlineatus* in California); 4 of them are insular

The existence of 3 species on the little Cedros Island is only partly an illustration of the effect of isolation—*C. labialis* on Cedros Island, *C. rubidus* only on S. Margarita Island; *maximus*, *tessellatus*, *martyris*, and *hyperythrus* occur on islands but also on the neighbouring mainlands, which consequently prove to be veritable refuge-islands, remnants of a formerly larger land-complex. Characteristic of, even peculiar to, this land are *C. labialis* and *C. hyperythrus*, whilst the other species are of *tessellatus* descent.

Another centre of great variety is Oaxaca, with likewise 6–7 forms which are referable to the *deppei* and the *gularis-communis-mexicanus* group. This great diversity is in concord with the very varied physical features of that State. It is there that the Tierra caliente embraces with an eastern and a western arm the most southern portion of the plateau, a wedge which is continued towards the Isthmus through its junction with the Sierra Madre del Sur. The Atlantic and Pacific types of hot climate are juxtaposed. The Southern species meet others of the *mexicanus* stock which have come from the North, at least from the plateau, and they meet others of the *communis*-stock which have come from the West. Or may be, if we prefer it, the Southern *deppei-group* has by its northward extension crossed the Southern members of the *communis-stock*, which extend from Colima along the coast across the Isthmus through Yucatan to Cozumel! Indeed, we can understand why the Oaxaca-Isthmus district should be so rich in forms. It is a highway, the meeting-ground of the South and North exchange, and at the same time so diverse in bionomic conditions, any but deserts or semideserts being there represented within a small compass.

The State of Oaxaca is the meeting centre of North and South, East and West conditions—a combination which occurs nowhere else in Mexico. In comparison, the rest of this large country, in spite of wonderful variety, shows far more fundamental uniformity, each of its main divisions in its way, and, as the map will show, with rarely as many as 4, more often only 3 or 2, and even only 1 kind of *Cnemidophorus.*

These facts are eloquent testimony that the diversity of bionomic conditions is responsible for the various kinds of these lizards. Never mind, for the present, whether this must mean either that natural selection has weeded out those variations which do not fit in, or that the bionomic conditions have actually caused these variations. Fortunately our *Cnemidophori* seem to testify that both views can go hand in hand.

The change of the pattern of a typical *C. mexicanus* from stripes to tiger-bars during its growth from youth to age shows that this change takes place side by side with natural selection, not beyond its control. Otherwise it would mean, as I have pointed out elsewhere, that all those are weeded out which in their youth do not happen to be striped, and those of the second year which do not happen to become spotted, and those of old age which do not manage to assume the cross-barred pattern! There are no young *C. mexicanus* which are not striped, but no old specimens with stripes.

In *C. deppei* the greatest number of stripes occurs in old specimens, and this fact is not due to the others having been weeded out, since many-striped young are not relatively but positively rare. If this many-striped pattern is best for this species, it is hard on the young to have to wait for it during the time that they are most in need of protection. The changes are constitutional and also caused directly by the external bionomic prevailing conditions, and some of the "protective" results are quite incidental; for instance, the fact that many a vividly striped *C. deppei* appears quite stripeless, monochrome dull, when seen from in front instead of sideways or from behind. This striking feature is the result of the still somewhat imbricating shape of the granules of the skin. If it were harmful it would be disallowed, if useful it might be encouraged; but if it be neither, it would still continue until it disappears by itself, when the granules have become too uniform for this accidental by-play.

Almost every one of the taxonomic characters investigated in this paper has an amplitude of variation within some of the species which equals that of the whole genus. From this fact we can draw several conclusions. Either these variations are unimportant to the welfare of that particular species, or this is still in an unsettled condition, *i. e.* it is making new species. If the exceptional or extreme variations were harmful, we should expect them to have been eradicated long ago; even the tendency of varying in that particular direction, unless this kind of variation is of comparatively recent date.

Again, since they occur in individuals of the same locality, they have obviously not been swamped by panmixis. All these *Cnemidophori* form practically isolated clans, since they do not travel. We might say that the inhabitants of a plain have more chances of mixing, and that therefore they are more monotonous in their features, have in fact arrived at the general average. Clans on the other hand confined in a valley, or on a mountain, or in intricate terrain, are isolated, and they should therefore be still more subject to panmixis. But instead of their having settled down to fixed monotony, we find just the reverse: the variations of their characters are at their liveliest. How are these facts to be reconciled? Only, I venture to submit, by the assumption that these variations are the direct result of, caused by, the direct influence of the surroundings, regardless of natural selection, which can, and will, step in only when certain variations turn out to be harmful in that particular locality.

It may mean an improvement to have 21 instead of 20 femoral pores, instead of increasing the work of each pore by 5 per cent.; but if that 21-pored lizard should mate with an old-fashioned 18-pored female, the offspring may probably show some gain in comparison with the mother. Whatever may be the use of these pores, their activity certainly depends upon the requirements of the whole organism of the lizard, which in turn is influenced by the conditions under which it happens to live. If that place favours, in the most roundabout way, the activity of these pores, they will react by increase, either in size or in numbers, perhaps actually thus increasing during the life of one individual.

Not all individuals respond alike easily. Some lag behind, and may be they come thereby to grief, although this is not very likely. Take the present case. What puts an end to the refractory lizard are the snakes, the ground-cuckoo, the Crotophaga, and similar enemies, whose attacks represent accidents absolutely regardless of the difference between 20 and 21 pores; but this same difference is equally irrelevant in affecting the creature's organism itself, since the 20 glands can easily do the extra work between them[*].

The same reasoning applies to the protection of the forearm. The nature of the ground over which these lizards have to run, conceivably may directly influence, stimulate, these gaiters composed of long rows of broad scutes. I leave it open, not always to rouse the anti-Lamarckian ire, whether the scutellation is due to natural selection; but I want to know why these same scutes are lost again by those delegates of a gaitered kind which have straddled into forests or upon sandy ground. Or, another point of view. The "granulated specimens" of *C. mexicanus* from Cuernavaca and Cuautla (*cf.* p. 367), or those of *C. communis occidentalis* from Patzcuaro, should be at such an obvious disadvantage to their gaitered brethren that these tendencies ought to have been eradicated long ago.

Would anyone be bold enough to stipulate a physiological difference between the possession of 3 or 4 supraoculars? Fine, instead of coarse, granulation prevails in the skin of the *deppei*-group; their whole organism is imbued with this acquired character, and this tendency is likely to spread, to assert itself in all those parts where scales and scutes are not positively required. In most species with normally 4 supraoculars these are bordered behind by one or more rows of granules; in some specimens the last supraocular is split, or much reduced (*e. g.* text-fig. 71 A, p. 303), and there are more granules, and granules fill its whole space in the *deppei*-group, except in those old-fashioned individuals, about 10 per cent. with rather local predilection, which still retain the original number. That is all, neither more nor less!

Every normal organism, and its constituent organs jointly or separately, tends towards greater perfection[†]. It is under the influence of the law of perfection. This must be so unless the whole idea of onward evolution is a dream, and it is a necessary outcome of the principle of the inheritance of acquired characters.

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[*] Here we are treading on uncertain ground. However, I have found many dozens of cases in which one or two of the distal pores of the whole series are imperfect, or very small, obviously not functional; and frequently on the other leg the corresponding pores are altogether missing. These may be cases of retrogression, of decreasing pores; but my argument is of course valid for de- and increase. Only, somehow, one prefers to consider the largest numbers as representing the ultimate, newest condition.

[†] I am well aware that I am treading here on dangerous ground and liable to be misunderstood. The process involved may be mysterious, but it is not mystical. "Perfection" and "law" are used for want of less equivocal turns; they are figures of speech, not concrete and absolute, but abstract and relative ideas. Few, if any, creatures are perfect in the sense that they cannot be improved. Ornithorhynchus may represent the acme of vertebrate perfection in the Murray River, but as a mammal it is lamentably imperfect. There is a "law of chances"; it is not a law made by the will of somebody, but a convenient expression for the average summary of facts as they result from the "nature of things." A squad of raw recruits may all make bulls' eyes, but they won't!

There is onward evolution and also degeneration or devolution or regressive metamorphosis, likewise after all progressive. To exclude the latter, I used the expression "normal organism" for the sake of shortness. Those who scent teleology in

Animals and plants have, since the beginning of life, acquired and inherited and retained whatever was better, and they have got rid of imperfections, so that this whole process itself has become an acquired and inherited character. Thus alone can it be explained that an organism can and will, under new circumstances, or under new and sudden stress, react in a manner surprisingly quick and straight to the point.

The *Cnemidophori* are so plastic that they still respond to every new condition, and in so varied a country as Mexico they are liable to meet with new conditions whenever they spread (not migrate!) into regions new to them. These need not be localities where no *Cnemidophorus* has been before. The whole process is now very complex. For instance, a clan of typical *C. communis occidentalis* may spread into locality A, which is already inhabited by *C. immutabilis*. More likely than not, it will there assume some of those characters which the prevailing conditions produce or require, and the result will be a superficial resemblance to *C. immutabilis*. Into this same locality spreads a clan of typical *C. mexicanus*, which also assume some of the characters which the aboriginal *C. immutabilis* possesses; but the result in these "immigrants" will not be the same, because *C. mexicanus* and *C. communis* are not the same.

A great resemblance between the three kinds of lizards will result in obedience to the *genius loci*. One of these may yield in the matter of pores and arm-granules and in the pattern of colour, but retaining its collar; the other set may concede nearly everything, but may stick obstinately to some other feature by which alone it proclaims its descent. Not because that point is necessary to its welfare, but because inheritance happens to be too strong, at least for the present.

The whole body, *i. e.* the sum total of all its characters, of which we can follow only a few, is considerably influenced by new environmental, bionomic conditions. All the characters, being therefore in an unstable condition, or shaken up, "vary" separately; some, however, with an obvious amount of correlation: with the result that many combinations are formed—some of them good, others bad or indifferent, and thus, seemingly by accident,

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orthogenesis,' tendency towards perfection, &c., may be referred to Hæckel's discussion of these and similar subjects in his 'Generelle Morphologie der Organismen,' Chap. xix. (Berlin, 1866); reprinted as Chap. ix. pp. 311-319 in 'Principien der generellen Morphologie der Organismen' (Berlin, 1906). There, p. 312, he uses the excellent term *Teleosis* for H. G. Bronn's "Gesetz der progressiven Entwickelung." On p. 317, Nægeli's "Vervollkommnungs-theorie," practically including Eimer's Orthogenesis, is discussed. Hæckel finds fault with Nægeli's expression that "all organisms have the *tendency* to become more complicated or perfect" as leading to teleology and dualism, but Hæckel's substitution of a "general mechanical law of Nature" does not mend matters.

The main purpose of an organism is to live! Of course that, again, is not a "purpose," but it is its business, *Geschaeft*, that what it is busy with, "das was er schafft"!

new varieties, races, &c. are formed, or at least initiated. Whether they can hold their own, can become common, or predominant, depends upon the test of life and time. In any case, when we speak of them as new varieties or races &c., we thereby but register the fact that the characters of these lizards in certain localities average differently from what we are pleased to consider the normal, more universal stock.

On the other hand, where environmental conditions are stable, or when the new homes imply no bionomic change, there should be no reason for shaking up the organism; it should arrive at a settled condition, and the only changes, if any, should be very gradual and orthogenetic, following the law of improvement.

It follows from these considerations, that the evolution of new species should be most active, most obvious in varied, not in monotonous districts. It also follows that change of environmental conditions need not imply migration, or spreading, but change of conditions *in loco.*

It is a kaleidoscopic process—a stirring up, and there are new combinations, some of transient existence, others are obvious failures, others are lucky hits which should be the most successful according to all canons. They seem to fall into the category of "mutations," but to a rather mild extent, since the game is played fairly with all the pieces or characters upon the board, none more and none less. The game has been played incessantly and in many places by these lizards, hence the possibility of the occurrence of the same combinations at different times and places; and such coincidences become probabilities when the performers are of a kindred stock and play under similar conditions those subtle rules and influences and traditions which Nature is able to "corriger la fortune."

The distressingly laborious examination of half a thousand specimens of *Cnemidophorus* has not been in vain, since it has revealed not a few instances which are favourable to the interpretations and to the general conclusions given in this paper. None amounts to proof, but even an occasional glimpse may lead to a path into and eventually out of a tangle which hides quagmires and precipices with its luxuriant and often thorny growths, but which above all attracts us by its glorious and mysterious beauty.

Definition of the genus CNEMIDOPHORUS Wagler, pt.; Boulenger, Cat. Lizards, ii. 1885, p. 360.—Swift-running, strictly humivagous Tejidæ, with a long, narrow arrow-headed tongue, not retractile into the base; lateral teeth compressed, bi- or tricuspid; head covered with large regular shields; anterior nasals in contact with each other; dorsal scales granular; ventrals large, forming regular rows; with a double collar-fold; with femoral pores; tail round; eyelids and ear-opening well developed.

A Key, or general definition of the main groups of Mexican and North-American Cnemidophori.

4 supraoculars. Collar composed of large scales. Posterior surface of forearm covered with granules. U.S.A. into Northern Mexico.
*C. sexlineatus**, p. 302.

4 supraoculars. Collar composed of large scales. Forearm normally with scutes, or enlarged polygones .... *Central* or *gularis-group*, p. 327.

4 supraoculars. Collar composed of small scales, especially the rows which form the posterior edge. Forearm posteriorly covered with granules ...... *North-Western* or *tessellatus-group* †, p. 367.

3 supraoculars. Collar composed of large scales. Forearm granular .... *Southern* or *deppei-group*, p. 308.

For comparison I give a few data of the *South-American forms of Cnemidophorus*. The first 5, *C. ocellifer* to *C. longicauda*, are closely allied to each other, and are all from Southern South America, *i.e.* extratropical. They are distinguished by the very small number of femoral pores; the position of the nostril is in the first nasal, *i.e.* "anterior to the nasal suture," as in the Mexicans (in the other South Americans the nostril lies between the two nasal plates); when there are only 3 supraoculars, this is due to reduction of the anterior scute, instead of the posterior as in the Mexicans. In this respect, therefore, the mere number is no indication of relationship with the *deppei*-group; it is rather the reverse.

We observe the same differences in the shape of the collar, some of the *tessellatus*, others of the *gularis* type: with or without granules at the edge, and, e. g. *C. leachi*, with intermediate conditions. The humerus is covered either with many small rows, or a few large rows, followed by smaller rows. But all the South-American species agree with the *tessellatus* and *deppei* groups in the entirely granular covering of the posterior side of the forearm; there being not one specimen known with scutes or even enlarged polygones.

Concerning the colour-pattern there seems to be the same amplitude of variation from adult species with many sharply defined stripes to those in which the stripes fade away, or are dissolved into round spots, mostly also with field-spots, *e. g.* in *C. lemniscatus*; lastly there are some which attain a monochrome condition.

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* Hereto possibly also *C. hyperythrus*, distinguished by the fusion of the two frontoparietals into one plate, p. 307.

† Hereto possibly *C. labialis*, distinguished by the nasal opening being in contact with the second upper labial, p. 374.

South-American CNEMIDOPHORI.

		Supra-oculars.	Collar.	Humeral rows.	Femoral rows.	Pores.	Colour-pattern.
ocellifer	Brazil.	4	Large.	2 or 3 large.	5–6	9–11	Spotted.
leachi.........................	Argentina.	......	Centre large, edge and sides granular.				
multilineatus	Mendoza.	3	Large.	3 large.	12	12	Striped.
lacertoides	Uruguay.	3 to 4	Large; granular edge.	Large.	5–6	10–12	Stripes and spots.
longicauda	Patagonia.	3	Scales all very small.	Large.	5–6	12–14	Striped.
murinus......	Curaçao.	4	Very small, almost granular.	Very small and numerous.	8	29–35	Green with large white spots instead of stripes 1 and 2, and in field I.
arubensis	Islands near Trinidad.	4	Small.	Very small and numerous.	8	...	„ „ „
nigricolor	Los Roques Coast near Caracas.	4	Very small.	Very small and numerous.	.....	. . .	Entirely black or black-brown: reminding of *C. martyris* of the *tessellatus*-group.
lentiginosus							
lemniscatus	Venezuela.	3 to 4	Large.	A few large with several small rows.	6; 7–8	18–24	Young with 8 to 10 stripes, which later on vanish or break up into pale spots.
espeuti	Old Providence Island, Colombia.	4	Large.	3 large + several smaller.	6–7	19	Uniformly dull green: reminding of *C. inornatus* of the *tessellatus*-group.
peruanus	Piura, Peru.						
vittatus	Bolivia.						
ameivoides	Costa Rica.						
heterolepis	Peru.	.....	. ...	....	17–19	. . .	Differing from all the other *Cnemidophori* by the possession of irregular large scales amongst the granules of the back.

CNEMIDOPHORUS SEXLINEATUS Linn.

(Text-figs. 71 A, B, C; 62 B; 65 D; 73 A, B.)

Material examined:—

4 from Raleigh, N. Carolina.
3 (1 each) from Pensacola, Florida; Kansas; Duval County, Texas.
2 from Bloomington, Indiana.
3 from San Diego, California.
4 from Sauz, north of Chihuahua (Coll. Dr. Meek).

Definition.—4 supraoculars. Collar composed of several rows of large scales (text-fig. 65 D); posterior surface of forearm with several rows of slightly enlarged granules (text-fig. 62 B). Underparts white; 6 to 7 white or yellowish complete stripes on the back; fields dark without spots (text-fig. 71 A, B, C). Size distinctly small, up to 70 mm.; an adult ♀ from Sauz, with large eggs, only 57 mm.

With very wide distribution in North America; from Maryland and Delaware to Illinois, Kansas, and Nebraska; southwards to Florida, through Texas to Laredo, thence to Chihuahua, Arizona, and into Southern California.

Linné's types came from Charleston, S. Carolina; Edit. xiii. p. 364: "Corpus supra utrinque lineis 3 albis angustis et totidem nigris alternis. Dorsum lineis 3 mediis interjectum, canescens quasi ex duabus lineis albidis. Rugæ duo sub collo."

Supraoculars 4; the posterior is separated from the parietals by one or more rows of granules, unless it is almost in contact with the parietals. Of the four Raleigh specimens only the largest has 4/4 complete supraoculars! In one of 68 mm. only 3/3; in the other of 68 mm. (text-fig. 71 A) the posterior is absent on the left side, on the right it is reduced to a large granule, and the anterior scute is broken up into several. The 58 mm. specimen has only 3/3, due to loss of the posterior scutes, but the anterior pair is broken up into several.

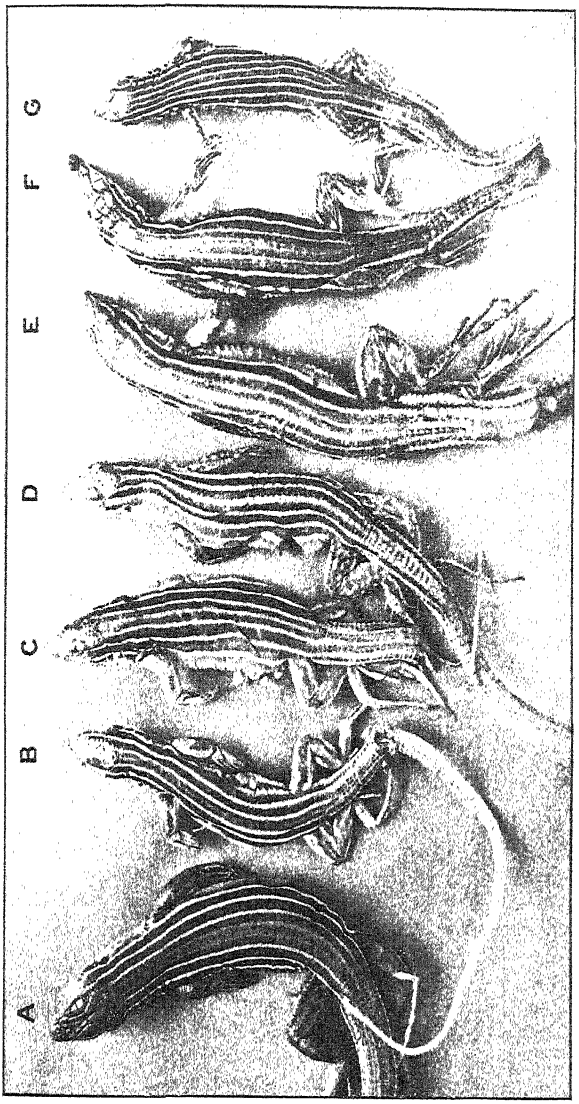
Frenocular plate variable. In two Raleigh specimens present, in one absent on both sides, in one present on the left side only. Absent in all the four Sauz specimens.

Collar (text-fig. 65 D).—According to Cope, "scales of collar larger, in few rows, the largest forming the lower." In reality the collar of *C. sexlineatus* is variable and closely approaches that of the *C. deppei*-group. Instead of the posterior edge being formed by a row of large scales, it is in many cases, at least in the centre, composed of granules only; or there are numerous granules interspersed between the scales of the edge. The large scales themselves often decrease in size rapidly towards the sides. Cope's figure is much more to the point than his description. The strongest collar, with an edge of large scales and but few or no granules, I find in the two San Diego specimens.

Humerus with 5 to 7 rows of scales, of which the first 2, 3, or 4 are considerably larger than the rest.

Posterior surface of forearm (text-fig. 62 B) covered with granules, but several rows of these, extending variably from elbow to wrist, are slightly enlarged. According to Cope, specimens occur in Texas, New Mexico, and Arizona with the granules more enlarged than in specimens from the Eastern States. Of four specimens from Sauz I find only one with conspicuously enlarged rows of

Text-fig. 71.



Cnemidophorus sexlineatus and *C. deppei.*

A = *C. sexlineatus*, Raleigh, N. Carolina; with 6 white and a double faint central stripe. 3,4 supraoculars.
B = *C. sexlineatus*, Sauz, Chihuahua; with 6 white and a very faint central stripe. 4,4 supraoculars.
C = *C. sexlineatus*, Sauz, Chihuahua; with 7 stripes.
D = *C. deppei*, Cocoyul 5; with 7 white stripes.
E = ,, ,, Balsas 6; with 7 stripes.
F = ,, ,, Balsas 16; with 3 pairs of stripes and central subdivided.
G = ,, ,, Cocoyul 3; with 8 complete stripes.

granules, another with very slight, almost imperceptible, and the rest with intermediate enlargements. In the four Raleigh specimens 2 or 3 rows of granules are slightly enlarged. In no case are the enlarged rows directly continuous with the posterior scales of the humerus. Anterior surface of forearm with 2, 2½, or 3 rows of plates.

Femoral scales according to Cope in 6 rows, less frequently in 7. I find 6 rows in the Raleigh specimens, three of the rows reaching the knee. Two of the Sauz specimens have only 5 rows, of which two are very large and alone reach the knee; another specimen has 4 to 5 irregular rows, and another has only 4 rows, of which the first is extremely broad.

Tibia with 2½ to 3 rows of plates.

Femoral pores 14–19. Raleigh, 15/16, 17/17, 17/18, 18/18; Sauz, 15/15, 15/16, 16/16, 18/17; Bloomington, Ind., 14/14 and 19; San Diego, 14/14 to 16.

Coloration.—Under parts uniformly white with a mother-of-pearl gloss, or blue-green tinge on the flanks. Above: ashy to black-brown fields without any pale spots; with three pairs of white to yellow complete stripes, in addition to a dull-coloured central streak. The latter varies considerably. It is either a faint line in the centre of the brown and broad mid-field 3–3, or it forms a well-marked streak, so that there are seven stripes in all; or, lastly, it is differentiated into a pair of pale brown lines which are separated by a dark brown central streak, so that there are 8 stripes in all, as, for instance, in the Raleigh specimens.

	Length. (mm.)	Collar.	Forearm.	Pores.	
Raleigh, N.C. (Cambridge Museum).	58	Weak.	3 rows of very slightly enlarged granules.	17	No field-spots.
" "	68	Moderate.	" "	17	" "
" "	68	"	" "	18	" "
" "	70	Rather strong.	" "	16/15	" "
Bloomington, Ill......	69	Weak, edge partly granular.	Enlarged granules and small polygones.	19!	No field-spots whatever.
" "	58	"	Somewhat enlarged granules.	14/14!	" "
Pensacola, Fla.	43	"	" "	...	No field-spots. 7 stripes.
San Diego, Cal. (4) ...	56–64	Strong.	3 with slightly enlarged granules.	14/14 to 16/16	None with field-spots.
		"	1 with small polygones.		6 and 7 stripes, 3/3 either parallel, with a long faint central streak; or enclosing an island as in some *C. deppei* with more numerous stripes.

The interesting question is whether C. gularis *and* C. sexlineatus *merge into each other.* According to Cope they do so in Texas, New Mexico, and Arizona. "If we refer specimens with fewer than 18 pores and no spots between the stripes or on the sides to the *C. sexlineatus*, we find that in certain specimens from the region in question [*e.g.* specimens from the Pecos River, from New Mexico, from Plateau Creek in Colorado, and from Fort Cobb in California] the post-antebrachial scales are larger than in the eastern specimens, though not so large as in the true *C. gularis*.

"In another series the post-antebrachial scales are equally intermediate in size and there are no spots, but the femoral pores are enlarged in numbers; for instance, specimens from Santa Fé in New Mexico, Camp Whipple in Arizona, and from Chihuahua. From these we pass easily to the true *C. s. gularis*, with large post-antebrachials and spotted spaces."

This sounds rather conclusive, but when put to a more scrupulous test there appear difficulties. For instance, we should expect, from Cope's statement, that it should be the Chihuahua district which is inhabited by truly intermediate links between *C. gularis* and *C. sexlineatus*. But it so happens that the 4 Sauz specimens have in all only 129 pores, *i.e.* average 16·1; hereby, and by their spotless colour-pattern, they are well on the side of *C. sexlineatus*, while only one approaches *C. gularis* in the covering of the forearm; and by their small number of femoral rows and in their small size these specimens stand quite alone. Moreover, the most enlarged polygones of the forearm are associated with only 15 pores.

Specimens from Bloomington and San Diego show that a decidedly low number of pores can be associated with a more polygonal forearm covering, and with a strong as well as a weak collar. Better links are the 69 mm. specimen from Bloomington, Illinois, and the 62 mm. specimen of *C. gularis* from Duval County, Texas, and this specimen would be a perfect link if it had 18 instead of only 15 pores. If the enormous material in the Smithsonian Institute were examined properly, it would no doubt yield truly intermediate links. For the present, the best criterion is the absence or presence of pale field-spots. Absence of such spots is associated with a rather low number of femoral pores, more granular forearm, and a weaker collar. Such small *Cnemidophori* are *C. sexlineatus*, common in the United States and extending to the plains of Northern Mexico, where they change, or have changed, into *C. gularis*.

Next comes the *important question whether it is always possible to distinguish* C. sexlineatus *from the less intensified specimens of C. deppei*—for instance, from such as have less than 8 stripes and have no black under parts.

Such critical specimens must show the following characters:—

Small size, below 70 mm.
Forearm granular.
Supraoculars 4.
Femoral rows of scales not more than 6.

Femoral pores less than 18.
Collar composed of large scales (see above).
No pale field-spots.
6 white stripes and a mid-field with 1 or 2 pale stripes.
Male with white under parts.

It will be found from examination of the tabular statistics of *C. deppei*, cf. p. 315, that such *C. deppei* actually occur in the lowlands of South Guerrero, notably between the coast and San Luis Allende. Specimens from other countries are ruled out of comparison either by their numerous stripes or femoral pores, &c. There is in particular one of the specimens from Cocoyul (text-fig. 73 C and text-fig. 65 E) which should be a fair test case. It happens to be a young male of 63 mm., and the only obvious differences from *C. sexlineatus* of Sauz (text-fig. 73 A, B) are the sharply marked black of the collar, and that the 4th supraocular is represented by a tiny remnant only. Since it is in this district of Guerrero that the 4th supraocular crops up not unfrequently, females, without the criterion of the black under parts, may easily appear undistinguishable from typical *C. sexlineatus*.

I consider this an example of extraordinary convergence of two perfectly "good species" which nowhere are known to commingle. Specimens of one clan of the northern species, in the very north of Mexico, and specimens of one clan of the tropical, southern species in South Guerrero, have hit upon the same combination of numerous characters so as to have become practically not distinguishable! There is scarcely a greater difference in physical features imaginable than between the wind-swept, droughty arid plateau of Sauz and the hilly woody lowlands of tropical Guerrero. It is inconceivable that members of the same species of *Cnemidophorus* (lizards which so obviously react upon the physical features of their surroundings) should vary in exactly the same direction in such absolutely different places. On the contrary, we must conclude that the two clans are of different species; in other words, that *these Sauz and Guerrero specimens are an illustration of convergence*.

At the same time, without attempting to quibble, we may consider it fairly proved that *C. sexlineatus* and *C. deppei* are very closely related to each other, so intimately that they might be considered as the two divergent races of one species, upon the ground that, taken in a lump, they have now been shown to "run into each other." Only, there are these grave difficulties. First, they do not live together but are hopelessly separated. Secondly, *C. sexlineatus* forms the starting-point for species like *C. gularis* with strongly enlarged forearm-scales and a strong collar, while the tendencies of *C. deppei* are the increasing number of stripes, black pigmentation of the males' underparts, and loss of the 4th supraocular. Lastly, from some form like *C. deppei* have been developed *C. immutabilis* and *C. guttatus*, lizards which have radiated in a direction opposite to that of the "descendants" of *C. sexlineatus*.

The principle here involved is to a certain extent expressed by the homely saying, "what is one man's meat is another man's poison." It may be expressed by the following equations:—If x and y are two lizards in an indifferent state, or before they have been subjected to very different modifying œcological conditions, A standing for Plain, B for Forest, and R the result, then $xA=R$ and $yB=R$, i. e. xA can only be $=yB$ if x and y are different, *i. e.* reacting differently; it being also inconceivable that the same kind of creature, if modified at all by the absolutely different factors A and B, should be modified into the same combination of characters.

$xA=yB.$

$x=\frac{yB}{A}$, i. e. x = 2nd species as it would be if adapted for Forest life, but modified by the Plain.

$y=\frac{xA}{B}$, i. e. y = 1st species as it would be if adapted for Plains, if it were not modified by Forest life.

Let us, for argument sake, assume that Plains favour the development of scutes on the forearm, 4 supraoculars and few pores; and that Forest life increases the number of pores, while it disallows or destroys scutes. Then our equation would mean:

$x=$ a Forest species which has been changed into one for Plain life; *i. e.*, it has developed arm-scutes, retains all the supraoculars but requires few pores.

$y=$ a Plain species which has been adapted to, or changed by, Forest life; *i. e.*, scutes are reduced and pores are increased.

In other words, x and y, the original stocks of *C. sexlineatus* and *C. deppei*, must have been different.

On the other hand, to assume $x=y$ would imply that $A=B$; physical conditions which we started with as being opposite to each other.

CNEMIDOPHORUS HYPERYTHRUS Cope.

Cope, Proc. Am. Phil. Soc. 1869, p. 159, established the genus *Verticaria* for those *Cnemidophorus*-like species which are distinguished by the fusion of the two frontoparietal plates into one. Such species are *C. heterolepis* Tschudi, from the neighbourhood of Lima, Peru, and *C. hyperythrus* Cope, from Lower California, in which I include, following Boulenger's advice, *C. sericea* van Denburgh and *C. beldingi*. *Hedracantha* Bocourt is, as Boulenger has shown, not a *Cnemidophorus* but an *Ameiva*, and does not occur in Mexico as stated erroneously by Bocourt and Cope, but near the coast of Peru and Ecuador. The fact that the fusion of the originally double frontoparietals occurs in two different genera, and the unique scaling of *C. heterolepis*, appear sufficient to disallow the fusion as a generic character. I am inclined to look upon these few "Verticarias" as remnants of a more Western, Pacific fauna, and in my paper Proc. R. S. 1905, I have given reasons which indicate a former westward extension of Mexico and Central America.

C. HYPERYTHRUS Cope=*sericea* Van Denburgh=*beldingi* Cope.

4 supraoculars.

Collar composed of large scales, without granules; the figure in Cope's posthumous work does not agree with his description, nor with the specimens in the British Museum.

Posterior surface of forearm with very slightly enlarged granules.

Femur with 6 irregular rows of scales.

Pores 16 to 17.

Length, a gravid specimen, 59 mm.; another 60 mm.

Range from Diego County in California apparently through the whole of Lower California to Cape San Lucas, including Cedros Island, and the Island of San José in the Gulf.

Coloration of under parts all white, with a slight blue tinge on the abdomen in the male. Upper parts striped, without any field-spots. In a female specimen (Brit. Mus.) the striation is the same as that of a *C. sexlineatus* from San Diego; there are three pairs of complete stripes with a faint central stripe. In a male specimen the third pair converges from the head backwards, forming an unpaired stripe from midback to tail; a unique case amongst *Cnemidophorus* with only 5 to 6 stripes, the third pair universally enclosing a broad mid-field. In the triangular short mid-field of this specimen is a very short whitish-grey faint mid-stripe from the head to the neck; fields uniformly dark grey to black.

In most of its characters *C. hyperythrus* very closely approaches *C. sexlineatus*, which also occurs in Diego County.

Deppei-Group.

Definition.—*Cnemidophorus* with normally 3 supraoculars (about 10 per cent. with 4); collar composed of enlarged scales in several rows; posterior surface of forearm covered with granules.

This group is restricted in Mexico to the Atlantic and Pacific Tierra caliente, and contains three well-definable forms.

Small, exceptionally up to 80 mm. in length, sharply marked with 7–11 pale stripes. Abdomen of adult male black. Collar and rest of under parts of female white: *C. deppei* (text-figs. 71 and 72).—From coast of Jalisco and Vera Cruz in the Tierra caliente inland up to 2000 feet, southwards through Central America (Nicaragua, Costa Rica) to Caracas in Venezuela. Concerning Island of Cozumel, see p. 316.

Larger, up to 138 mm. Collar of both sexes black, in contrast with throat and chest. Abdomen whitish, chequered with blue: *C. guttatus.*

A. Throat pale, whitish. Back with conspicuous white stripes on very dark ground, or the stripes are broken up into rows of numerous white spots: *C. guttatus immutabilis* (text-fig. 74).—From Colima to the Isthmus of Tehuantepec, from the coast of Oaxaca and Guerrero extending inland up to an altitude of 2000 feet.

B. Throat during life dull brick-red. Ground-colour of back dull olive-brown, with several obsolescent rows of yellow-white spots: *C. guttatus guttatus* (text-fig. 75).—Atlantic Tierra caliente from Vera Cruz to Tehuantepec, restricted to the lowlands of less than 1000 feet elevation.

CNEMIDOPHORUS DEPPEI Wiegmann.

(Text-figs. 71 D–G & 72 A–G.)

Number of specimens examined, 152.

Size of adult ♀, 60–71, average 63–65 mm.; of adult ♂, 66–83, average 70–75; exceptional length of 79, 81, and 83 occurring once each.

Supraocular shields.—The normal number is 3. Amongst the 113 specimens of my own collecting are 11 exceptions, *i. e.* nearly 10 per cent.: 4 with well-developed 4th shields on both sides, 4 with a tiny 4th scale on both sides, and 3 with a tiny 4th scale on one side only. 6 of these exceptional specimens belong to the 20 which were collected between the Pacific coast and San Luis Allende; 3 others belong to the 21 specimens from Tierra Colorada. All the rest are normal, amongst them all the 26 specimens from Rio Balsas and the 26 from Tequesixtlan.

Front of humerus protected by 3 longitudinal rows of enlarged scales, or by 4 to 5, or 5 rows which are correspondingly smaller. These scales extend backwards onto the elbow, without their forming a separate nest; but, becoming still smaller, almost granular, they may extend onto the back of the forearm.

Posterior side of forearm (text-fig. 72 D & F) covered with granules which are arranged in longitudinal rows. In about 10 per cent. these rows are composed of slightly enlarged granules, which either form a little cluster or nest in the middle of the posterior surface of the forearm, or they form the continuation of the scaling from the humerus and extend more or less down the forearm. In no case can these enlarged granules be called polygones; frequently the difference in size from the surrounding granules is so small as to escape the naked eye.

Anterior side of thigh.—There are generally 3 parallel rows of considerably enlarged scales, which rows extend down to the knee. Counting from the outermost or largest of these rows inwards, across the thigh, to the femoral pores, there are in all about 5 or 6 rows, rarely more or less. They are, however, not always complete; frequently a row is represented by a few scales only, which are intercalated and thereby considerably upset the regular lines, which then are not easy to count; but a rule-ofthumb procedure, applied to 86 specimens, gives the following result:—

Number of femoral rows ...		4 to 5	5	6	6–7	7	8	Mean number of rows.
Southern Oaxaca	No. of specimens	..	3	10	1	2	1	6·0
Coast of S. Luis		2	10	8	1	...	...	5·4
Tierra Colorada		...	1	17	2	2	...	6·0
Rio Balsas		...	...	11	1	14	...	6·5
		2	14	46	5	18	1	specimens.

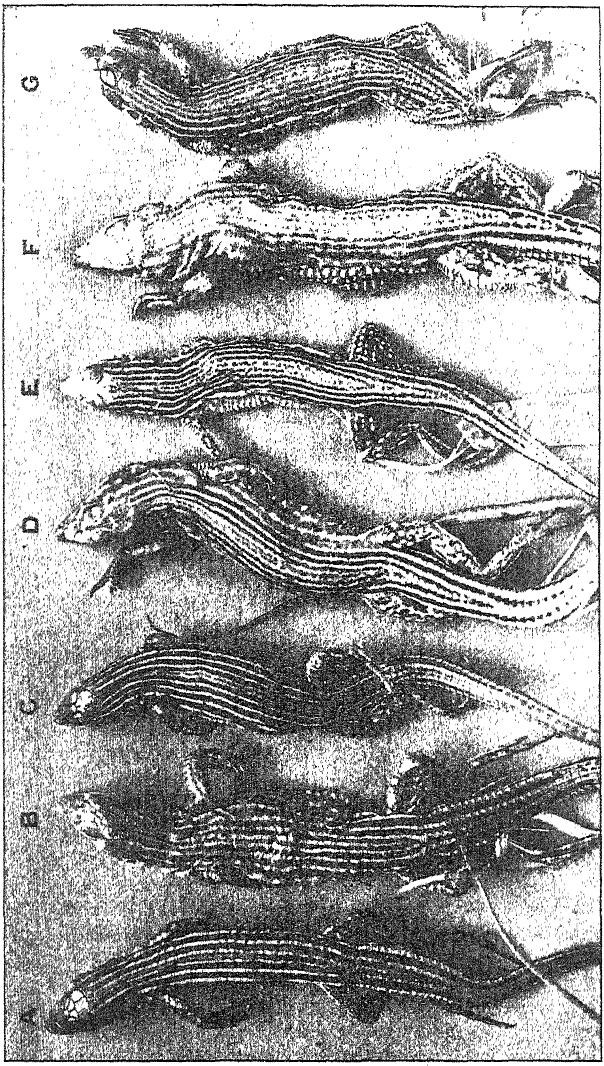
This tabulation is naturally very imperfect, not to say crude, but the results will not be altered when we throw the intermediate or doubtful cases of 6 to 7 rows either into the column with 6 or into that with 7 complete rows. There were, for instance, amongst the Oaxaca specimens four with 5 or 6 rows, but amongst those of Guerrero only two such doubtful cases. The fact remains, that, if we take Tierra Colorada as normal, those further south tend to possess fewer femoral scales, whilst those further north, at Rio Balsas, have decidedly more scales. This does not seem to be the result of mere chance, because, as we shall see, the Balsas specimens are remarkable for other features, although they are not peculiar to them. Amongst the specimens from the State of Oaxaca no difference whatever can be discerned with reference to their habitat nearer to or further away from the coast.

At any rate the amplitude is considerable, the extremes being two specimens with an imperfect 5th row, and one with 8 rows; the latter specimen, from Tequesixtlan, is in every other respect a typical *C. deppei*.

Inner side of tibia protected by 2, 2½, or 3 complete rows of enlarged scutes.

Preanal region.—As a rule there are 3 large scales which form a triangle, with two at the base and a third of equal size on the top, but sometimes a fourth scale forms the apex; or the two basal scales are small, whilst the third is correspondingly enlarged. In the majority the whole cluster is separated from the ventrals by a very short isthmus, sometimes so short that the cluster and the ventrals almost touch each other. The isthmus itself is mostly covered with very small scales, and when these are larger they are fewer in numbers. The whole character is worthless.

Femoral pores.—The number of pores frequently differs on the right and left side by one, rarely by two, in the same individual. There is no preference for one side. The smaller number in these cases of asymmetry is always due to one or more pores remaining undeveloped at the proximal, or more frequently at the distal end of the series. For comparison, the higher number should therefore always be taken. The amplitude of individual variation is considerable, when we recollect that these pores correspond in numbers with transverse rows of scales. But unfortunately the greater number of pores does not always correspond with a greater proportionate length of the thigh, since in many cases of small numbers the pores stop short a considerable distance above the knee, leaving a gap instead of going right down to the knee. However, other things being equal, the greater number of pores corresponds with a greater length of thigh.



Cnemidophorus deppei.

A from Miahuichan, 2; with 4 pairs of stripes and faint narrow central stripe.
B = Tierra Colorada, 10; with 9 complete stripes.
C = San Luis Allende; with 10 stripes.
D = Tequesixtlan, 16; with 10 complete stripes and a short central; first stripe beady.
E = Tequesixtlan, 3; with 8 complete stripes and centre dividing into 3.
F = Tequesixtlan, 23; with 10 complete stripes and very light centre.
G = Tequesixtlan, 4; with 11 complete stripes.

The amplitude of variation I have found, in 100 specimens, to extend from 14 to 22, but the solitary case of 14 was quite exceptional, it being associated with 16 on the other leg; and 22 likewise occurred once only, being coupled with 21 on the other side. 15/15 occurred twice, 15/16 twice, 16/16 four times, 21/21 only two or three times. The usual numbers are 17 and 18.

The specimens from Tierra Colorada possess the highest number, average mean 18·8; those of the Pacific side of Guerrero have the smallest number, average 16·2, and this smallest number coincides with the lowest number of femoral scales. The Balsas specimens take up a middle position, with 17·5 as their mean.

The appended table refers only to such localities in which sufficient material was collected. It also shows that the right and left sides are practically equal.

		Total number of Pores.		
Tequesixtlan. 18 specimens.	………	Right 333	Left 337	Mean 18·6 Pores.
Tierra Colorada 23 specimens.	………	„ 434	„ 429	„ 18·8 „
Rio Balsas. 25 specimens.	………	„ 442	„ 437	„ 17·5 „
Coast to S. Luis. 19 specimens.	………	„ 324	„ 311	„ 16·2 „
		1533	1514	17 or 18

Length of hind limb.—The claw of the fourth toe usually reaches the ear, but sometimes it falls a little short of it.

Throat (text-fig. 65 C, E).—Some of the granular scales covering the upper half of the throat are, as a rule, slightly larger in the centre than nearer the sides; occasionally they are large enough to form an ill-defined little cluster, which, however, is rarely so conspicuous as it is in many specimens of *C. immutabilis* (text-fig. 65 A).

The Collar (text-fig. 65 C, E) varies much in composition. In the majority, one or more rows of the large scales extend right across, while in *C. immutabilis* the large scales are mostly confined to the middle third, becoming considerably smaller towards the sides. The presence or absence of tiny granules on the posterior border of the collar is no criterion whatever in any species of *Cnemidophorus*. They are either absent, or here and there one is intercalated between the scales, or they form a single, or even several complete rows of granules. Lastly, it is to be noted that this character is often due solely to the shrinking of the soft granular fold in spirit-specimens.

Coloration (text-fig. 66: text-figs. 71 & 72).—The variations in colour and pattern extend far beyond the limits which I was able to describe in my first paper. The range of white or pale longitudinal stripes extends from 6 to 11; and the whole of the under parts, from the jaws to the anal region, varies in adult from uniformly silver-white to deep black. It is important to note that some of these variations seem to coincide with geographical districts.

Rio Balsas: 34 specimens (text-fig. 71 E, F).—The general impression made by these specimens is that they are rather effacing than increasing or emphasising their stripes on the mid-region of the back. Only stripes 1 and 2 are always white, while the third pair is often thin and dull. The chief variations occur in this mid-field, which is enclosed between stripes 3–3. In the 9-striped specimens stripes 4 + 5 + 4 always form a dull field or complex.

The chief variations are as follows:—

(1) The space between stripes 3–3 is lined with a dull brown band on either side, enclosing a central, rather broad and green mid-stripe, which is sometimes so broad it can scarcely count as a stripe, looking rather like the pale mid-field of a 6-striped lizard. Such 6- or 7-striped specimens are represented by 1 very young, 2 adult females, 1 immature ♂, and 4 large adult males.

(2) This 4th or central stripe is dull or dusky, and lined on either side by a thin whitish line, the beginnings, or remnants, of stripes 4–4, and there is in most cases a central, very weak and pale 5th streak which extends from the occiput over the neck, rarely to between the shoulders. Such 8-striped specimens are represented by 2 very young examples and by 11 adult females, in only three of which the stripes 4–4 are at all well defined. In one 7-striped male, 69 mm. length, the central green stripe shows a faint indication of being divided in the centre by a thin dark line; a transitional stage from the 7- to 8-striped condition.

(3) As before, but the stripes 4–4 are better marked, and the 5th, impaired streak extends from the head to the middle of the back, rarely to the rump. Such more or less completely 9-striped specimens are 6 adult females and 6 adult males.

Field I. is always conspicuously black or black-brown in the females, and the lateral band or field below it is dull and inconspicuous.

In the males, field I. is mostly dull ashy brown, while the lateral field inclines to brick-red, often with strikingly pretty effect. But there are no white spots in any of the fields nor in the lateral field.

All the under parts of the females are white, more or less mother-of-pearl, with an occasional tinge of green or bluish towards the flanks. The under surface of the tail is white, bordered with dusky or bluish colour.

In the males the under jaw, whole throat, collar, chest, and abdomen are uniform bluish black, and this extends over the preanal region, and over the under surface of the fore and hind limbs. The tail is white, bluish towards the sides.

In both sexes stripe 1 extends upon the front of the thigh, reappears on the whole of the posterior side as an unbroken white line, and is continued along the side of the tail.

Tierra Colorada: 21 specimens (text-fig. 72 B), 1 from South slope of Los Cajones, and 1 from Ayutla.—This is an essentially

9-striped assembly, in which all the stripes are conspicuous and well separated or emphasised by dark fields.

In 1 immature 9-striped male the central or 5th stripe is long, but represented by a dotted line only.

In 14 ♂ and 2 ♀ the 9 stripes are complete.

In 1 ♂ and 3 ♀ the central stripe is divided into two, indicating 10 stripes.

In 1 ♂ and 1 ♀ (the largest ♀ known) there are 10 stripes.

The females have the under parts white, and the dorsal stripes are all very sharp and white on a mostly black ground. In the males, the under parts are black, with the exception of the throat which is whitish; in only a few old males the black colour extends from the collar a little way up the throat, sometimes covering its lower half.

The lateral field and field I. are uniformly brick-red to bright red, but this colour, of strikingly beautiful effect in the live lizard, is liable to fade in spirit. In only four males occur pale spots in the first and in the lateral field, and some of these spots begin to invade stripe I. The white spots are most pronounced in the only male which is devoid of red bands; length 75 mm., throat mottled with black.

Pacific Coast to San Luis, Guerrero: 23 specimens.—With 7 to 10 stripes, which are always sharply marked, and there is no faint mid-field between stripes 3–3.

7 stripes occur 3 times, in 1 adult male and in 2 younger males, one of them with an indication of division into 8 stripes.

8 stripes occur 6 times, in young and old of both sexes.

9 stripes, the central stripe being rather faint, or short, occur 5 times, in young and old of both sexes.

9 stripes, all distinct and complete, occur 7 times, in young and old of both sexes.

10 stripes occur twice, in young females.

The stripes are most prominent in the females, because of the fields being black. Red or reddish field-bands in the males are rare. Only two specimens have both lateral and first field red; in a third only the lateral field is red, and in a fourth both fields are pale reddish brown. In the majority these fields are dull, with faint lighter spots in the first field, and the posterior half of stripe 1 is liable to break up into white beads.

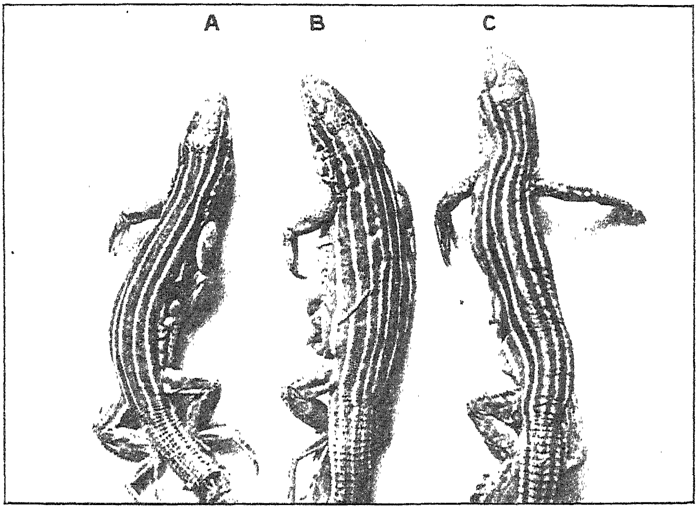
The under parts of the males are black, with the exception of the throat, which is greenish white, very rarely with a slight suffusion of black; but the 3 males from Miahuichan have entirely black throats like the Balsas specimens.

Perhaps the 23 specimens enumerated above, from the Coast land of Guerrero, had better not be dealt with summarily, since they show some marked local peculiarities. Unfortunately I could collect only limited numbers, 5 at Cocoyul, 3 at Miahuichan, and 3 at San Luis Allende, and the remaining 12 are likewise not all from one place only.

The following local variations seem to be worth noting:—

Of the 5 Cocoyul specimens, one has 7 (text-fig. 71 D), all the others 8 stripes (text-fig. 71 G); throat of males suffused with blackish.

Text-fig. 73.



Cnemidophorus sexlineatus and *C. deppei.*

A = *C. sexlineatus*, Sauz, Chihuahua; with 6 clear and a very faint central stripe. 4 4 supraoculars.
B = „ „ „ „ with 7 complete white stripes. 4 4 supraoculars.
D = *C. deppei*, Cocoyul 5; with 7 complete white stripes. 3 3 supraoculars.

The 3 Miahuichan specimens, all males, have 9 stripes; throat and jaw blue-black; flanks without any red.

The 3 San Luis specimens (text-fig. 72 C) have 9 and 10 sharp stripes; throat of male mottled; lateral field reddish; in both females the stripe 1 is reddish, and one of these females with 10 stripes has an additional white stripe which runs in an unbroken line from ear to hip. These San Luis specimens are also remarkable for the low number of femoral pores, namely 15 and 16; and two of them possess remnants of the 4th, posterior, supraoculars.

Southern Oaxaca.—These 48 specimens (text-fig. 72 D–G) form the bulk of those described in my previous paper. The characteristic features are:—

(1) The range of white stripes from 8 to 11, the increase apparently coinciding with age; the percentage of 10 or 11 stripes amounting to 70 per cent. is much greater than in the 88 Guerrero specimens, amongst which occur none with 11, and only about 4·5 per cent. of 10-striped specimens. On the other hand, Oaxaca

specimens with only 8 white stripes and with a narrow uniformly darker centre are very rare.

(2) The scarcity of black on the collar and throat of the males; only in 6 males was the collar black or inclining to black, although in one adult male from Tequesixtlan the whole throat was blue and partly suffused with black from the collar upwards.

(3) Tendency of stripe 1 and even of stripe 2 to break up into beads, and the appearance, advancing with age, of white spots in field I. and in the lateral field, so that one or two additional lines of beads may be developed in this lateral field.

This breaking up of the first stripe into beads occurs also in some few specimens of Tierra Colorada, and in one of the 7-striped specimens from San Luis.

Vera Cruz, near the seashore: 7 specimens collected by Dr. Meek. 1 with 8 stripes, 5 with 9 stripes; and in a young specimen the central, 5th stripe, is restricted to the nape and neck. Throat and collar not black.

Las Peñas, Jalisco, near the seashore: 4 specimens collected by Dr. Buller, Brit. Mus.

1 very young specimen of 33 mm.; with 10 stripes, and with an additional faint line on the flanks.

1 ♀ of 45 mm.; with 10 stripes, and with an additional weak line.

1 ♀ of 54 mm.; with 9 stripes, and with a stronger line.

1 ♂ of 65 mm.; with 9 stripes; with two additional long lines of white beads; moreover stripes 3 and 4 are dissolved into beady lines. Throat and collar black, abdomen blue.

Colima.—Cope's description of *Cnemidophorus lineatissimus*, Proc. Amer. Phil. Soc. 1877, p. 94. Black, with 10 or 11 pale bands, sides and femora pale-spotted; throat black. This and the rest of his description refer obviously to 10- or 11-striped male specimens of *C. deppei*, resembling some of those of Oaxaca and Las Peñas in Jalisco. Cope gives "Guadalajara" as another locality, a very doubtful statement. The plain of Guadalajara, with its elevation of more than 5000 feet, is absolutely above the range of *C. deppei* and *C. immutabilis*, which are essentially hot-country species; but it is possible that Cope's specimens came from the barranca, through which flows the Rio Santiago, a few hours' ride from the town, and 2000 feet lower than the surrounding plateau.—Bocourt, Miss. Scient. Mex., described two specimens from "Colima," with 9 stripes.

CNEMIDOPHORUS DEPPEI, var. COZUMELA.

4 specimens from the island of Cozumel, East Coast of Yucatan. British Museum.

Length 64–71 mm.; the largest specimen is gravid.

Collar like that of *C. deppei*.

Supraoculars: one with 3/3; two with 3 left, right posterior very small; one with 4/4, the posterior very small. In this respect resembling some of the *C. deppei* of South Guerrero.

Posterior side of forearm covered with granules, which in three specimens are slightly enlarged towards the elbow; in one specimen enlarged near the elbow into small polygones.

Femur with 6 rows of scales, of which three extend to the knee.

Femoral pores 15, 16, 17, and 18.

Not only the first, but also the second, and even the third upper labials are denticulated.

The under parts are pale, with a mother-of-pearl lustre; but the coloration of the upper parts is very peculiar. There is a very broad mid-field which is uniformly brown; between it and the flanks are on either side 4 to 5 very narrow, continuous, but trembling, white lines. One of the five stripes lies below, ventrally from, the usual 1st stripe, which extends from the ear to and upon the thigh. Such an extra stripe is known in otherwise 10-striped *C. deppei* of Tehuantepec, while an unusually broad mid-field occurs in the 8-striped specimens of San Juan Evangelista.—Combination of an extra stripe on the flanks with a very broad mid-field I have found in one specimen of Tequesixtlan, but in all these continental specimens the stripes are straight, well-defined lines, not wavy or trembling.

Summary concerning C. deppei.

When we reduce the results of the tedious examination of the 152 specimens to a few sentences, they become vague because of the great amplitude of the variations. As typical averages may be mentioned:—

Supraoculars 3, exceptionally 4, bordered behind by only one narrow strip of elongated granules.

Collar complete, the large rows of scales mostly reaching right across; posterior border with or without granules.

Throat very rarely with a central cluster of larger scales.

Front of humerus with 3, 4, or 5 larger rows.

Posterior side of forearm covered with granules.

Anterior aspect of thigh with 4½ to rarely 8 rows, mostly 6, the three largest of which reach down to the knee.

Femoral pores 14–22 of rare occurrence, usually 17–18.

Coloration.—Adult males with blue-black chest and belly. Under surface of tail blue and white. Upper surface always striped: 7–11 stripes, of which the first, rarely also the second, may dissolve into beads. White spots appear occasionally in the lateral field and in field I.

The under parts of females are never black or blue, neither collar nor belly.

As a rule, with very few exceptions, the first stripe extends upon the thigh, and reappears on its posterior side as an unbroken white streak.

Size.—Distinctly small, very rarely surpassing 80 mm.

Each of the four main districts, in which I have personally collected a sufficient number of specimens, has its characteristic type: local clans of this small lizard:—

I. The Basin of the Rio Balsas.—There are no *C. deppei* to the north of it, even a few miles away from the river, and towards the south they are separated from their kindred by the densely wooded and elevated intricate mountains of the Sierra Madre del Sur, which is inhabited only by *C. mexicanus* var. *balsas*.

The Balsas clan of *C. deppei* is noteworthy for the greater number of femoral scales, the average number of femoral pores, the black-blue colour of the whole under surface of the males, and the frequency of brick-red lateral fields; lastly, the poorly developed stripes on the mid-back.

II. Tierra Colorada, to the south of the main ridge of the Sierra Madre, in Guerrero.—Average number of femoral scales, combined with the greatest number of pores; conspicuously 9-striped; adult males with two red bands on each side; throat not black: collar, chest, and belly black.

III. The Lowlands of Southern Guerrero.—Smallest number of femoral scales and pores; 7-10 sharp stripes, while reddish bands are rare: faint light spots in the first field are frequent and the first stripe tends to break up into beads. Otherwise like Clan II., with which these southern specimens are geographically continuous. Note the difference in coloration of the three specimens from near Miahuichan, which lies on the southern outlying slopes of the Sierra, at an elevation of 1500–1600 feet, agreeing in this respect with Rincon at the foot of Los Cajones. The single Cajones specimen is the most blue-throated of the whole Tierra Colorada clan, and the Miahuichan specimens are remarkable chiefly for the partial extent of blue and black upon the throat.

IV. States of Oaxaca and Vera Cruz.—Average, or great, number of femoral scales, with greatest number of pores. Preponderance of 10–11 stripes, with development of conspicuous white spots on the flanks and breaking up of the first stripe into beads. Absence of red bands; black on the throat is very exceptional, rare even on the collar.

The structural characters vary too much for generalisation, as shown by 26 specimens, all from Tequesixtlan. The remaining 34 specimens came from eight different districts, and therefore afford no sufficient basis.

Now, it is quite conceivable that in two geographically separate clans the following combinations might become universal.

A. Supraoculars 3; femorals 7; pores 19; stripes 7; fields red; throat and collar black.

B. Supraoculars 4; femorals 5; pores 16; stripes 9–10; fields not red; throat and collar white.

Either of such groups would be entitled to at least subspecific rank. But there is not yet any clan known with such a combination. As they stand, they must therefore be satisfied with the rank of local races. It so happens that, for instance, the Balsas and the Southern Guerrero groups differ rather much from each other, but they do so only in the aggregate; whilst not a single individual combines all the extreme combinations of those very extremes of variations which singly are quite frequent in the same group. In other words, each individual still remains within the pale, and it almost appears as if the excursion of one or more characters well beyond the average of another species were carefully counterbalanced by the most typical behaviour of the rest of the characters. Still, we have in these kaleidoscopic *C. deppei* a very fair example of the way in which they might settle into different, definable races, varieties, or subspecies.

There remains the question, whether C. deppei, *as a species, can always be distinguished from other Cnemidophori*, especially from small-sized individuals of the striped *C. immutabilis**. Now, it so happens that, although these two kinds overlap absolutely in every one of their characters, I have not found one amongst more than 200 individuals examined about which there could be any doubt. At least, it so happened that the occurrence of exceptional extremes was always counterbalanced by such a typical development of the remaining features, that uncertainty was set aside. This is of great importance. The two species, with much the same distribution, and structurally so closely allied that they overlap by all their characters taken separately, do not "run into each other." We have to conclude that they are no longer nascent, but well established forms. It seems probable that they have sprung from the same not remote ancestor, and they now are "specifically" distinct, so much indeed that they now have not only practically the same distribution in Mexico, but that they can live side by side. Their difference in size is sufficient to exclude interbreeding. It would be a pure assumption that an exceptionally large male *C. deppei* might pair with a small *C. immutabilis*. But supposing that hybrids were possible, such intermediate specimens have not yet been found.

I have caught one immature *C. immutabilis*, length 81 mm., near Rincon (text-fig. 71 E), at the southern foot of the Cajones, which in most structural respects bears a striking resemblance to a young male *C. deppei*, length 61 mm., from Rio Balsas, where *C. deppei* alone occurs with *C. mexicanus*.

The Rincon specimen reveals itself as *C. immutabilis* by the following characters:—(1) Collar lead-coloured, rest of under parts pale; in a male *C. deppei* of this size the whole chest and abdomen would be deep blue-black. (2) The centre pair of the eight stripes is broken up into series of short streaks. (3) Humerus with at least 7 rows of large scales. On the other hand, the Rincon specimen has only 7 femoral rows, like the Balsas specimen, and three of these rows extend right down to the knee, an essentially *deppei*-like character. Both specimens have 3 complete rows of tibial plates, both have the posterior border of the collar formed by complete rows of granular scales, and both have a long preanal isthmus covered with many small scales. The Rincon specimen has 17/20, the Balsas specimen 19/18 femoral pores. Consequently both are exceptional, aberrant of their own kind taking on the typical features of the other species. If it were not for the pattern and coloration, which in the Rincon specimen are decisive, the decision would lie with the femoral plates, which in their numbers agree with one, in their extension to the knee with the other species!

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* For comparison with *C. sexlineatus*, see p. 306.

CNEMIDOPHORUS GUTTATUS Wiegmann.
(Text-figs. 67, 74, & 75.)

Material examined 61 specimens, from the following localities:—

15 Agua fria, western border of State of Vera Cruz.
2 San Juan Evangelista, State of Vera Cruz.
4 La Antigua, near Vera Cruz.
1 "Vera Cruz."

22 typical *C. guttatus*, all from the Atlantic Tierra Caliente.

1 Salina Cruz.*
1 San Mateo del Mar.*
4 Tequesixtlan.*
4 San Geronimo*, Isthmus.
4 San Domingo de Guzman*, Isthmus.
4 Cocoyul.*
4 South of and at San Luis Allende.
1 Miahuichan.*
11 Ayutla.
2 Tierra Colorada.
3 South slope of Cajones.*

39 from the Pacific Tierra Caliente. Those marked * are the more typical *C. immutabilis*.

Size, from nose to vent.—Any Guerrero specimen above 100 mm. is a fairly large male; near the Isthmus and in the Atlantic Hotlands both sexes reach a larger size, and one giant male from San Domingo measures 138 mm. The smallest are those of the inland districts of Guerrero, from Los Cajones to Ayutla and San Luis Allende.

Supraoculars, normally 3, the space behind filled with numerous granules. About 12 to 14 per cent. are exceptional: three specimens out of the four from Tequesixtlan, one with 4/3, another with 4/4, and the third with 5/5, due to an extra rather large scute in front and behind the normal plates. Similar irregularities occur in the typical *C. guttatus*, for instance from Agua fria, with 3/4 or 4/3.

Collar (text-fig. 65 A) as in *C. deppei*, but the enlarged scales of the transverse rows often decrease more rapidly towards the sides, especially in *C. guttatus*. One or two rows of granules at the posterior border of the collar are perhaps more frequent in *C. guttatus* and *C. immutabilis* than in *C. deppei*.

Throat (text-fig. 65 A).—In perhaps the majority of *C. immutabilis* the scales on the centre of the throat are somewhat enlarged so as to form a conspicuous cluster, but there are many in which such a cluster is ill-defined, or absent, regardless of age, sex, and locality.

Front of humerus protected by scales which vary much in size and in numbers. The size decreases from the anterior or outer margin backwards. Sometimes there are only 3 rows of distinctly enlarged scales, followed by much smaller scales which are continued upon and slightly beyond the back of the elbow; or there are 4, 5, 6, or even 7 rows of larger scales, and in these latter cases most of the scales are of medium size. Sometimes there is a break, filled by granules, between the anterior larger scales and those on the posterior side above the elbow, which in such cases form a little cluster or nest. Such a nest occurs in Atlantic and in Western specimens. Otherwise the Atlantic specimens seem to be remarkable for possessing only 3 enlarged rows.

Posterior side of forearm (text-fig. 62 A).—There are no postantebrachial plates. Almost universally, without exception in the Atlantic specimens, the posterior surface from elbow to wrist is covered evenly with small granules.

Anterior side of forearm.—Mostly with 2½, sometimes with 3, longitudinal rows of transversely broadened plates, very variable in detail.

Anterior side of femur.—The number of longitudinal rows of scales and plates, between the granules of the dorsal surface and the row of femoral pores, is considerable, about 10 to 12. One row is always distinctly larger than the rest. Including this row, and counting thence to the pores, across the thickest part of the thigh, there are from 7 to 10 rows, mostly 8 or 9. Only in rare cases are all these rows regular; frequently one or more rows are very incomplete, being represented by a few irregularly intercalated scales. The smallest number of rows, wavering about 7 (in one case with even this number imperfect), I have found in the five specimens from and near San Luis; these specimens are in other respects not at all aberrant, but rather typical *C. immutabilis*. In an adult male from Agua fria are only 7 rows on the left, and 8 very incomplete rows on the right thigh; in another specimen 8 complete right and 9 complete left rows.

Whilst in *C. deppei* usually the three biggest rows, rarely only two, reach down to the knee, in *C. guttatus* + *immutabilis* even the biggest row does but rarely extend to the bend of the knee.

Inner aspect of tibia protected mostly by 3, often by 2½, exceptionally only by 2 rows of large plates.

The *preanal* cluster of plates and scales is separated from the ventrals by a rather long and narrow isthmus which is covered with tiny scales, and as a rule these are sharply marked off against the much larger ventrals.

Femoral pores. The commonest numbers are 20 and 21, the usual range extending from 19 to 23. Quite exceptional was the occurrence of 17, 20 in a tall specimen from Ayutla, and another from the foot of Los Cajones. 18 did not occur. 23 pores, mostly on one side only, were observed 4 times.

Length of hind limb. The claw of the fourth toe usually reaches the ear, but in one specimen from Ayutla it only reaches the arm, whilst in another from exactly the same locality the limb is so long that the claw extends to the eye.

Coloration of under parts. The *collar* is normally black in both sexes. Even in the young of only 50 or 56 mm. in length, it begins to become dusky or speckled on the sides. Sometimes, however, even in adult males during the breeding-season, the collar is not black but leaden, in rare cases almost dull whitish. In other cases the black spreads sometimes onto the neighbouring parts of the *throat*; in a specimen from Los Cajones the whole throat is blue-black, and in all the four specimens from San Domingo, Isthmus, the throat is black. In the majority of cases the throat is whitish or pale lead-colour. Lastly, in the adult males, and even in some females of the specimens which I observed and caught at Agua fria, the throat was light brick-red, but this red fades away completely in spirit specimens.

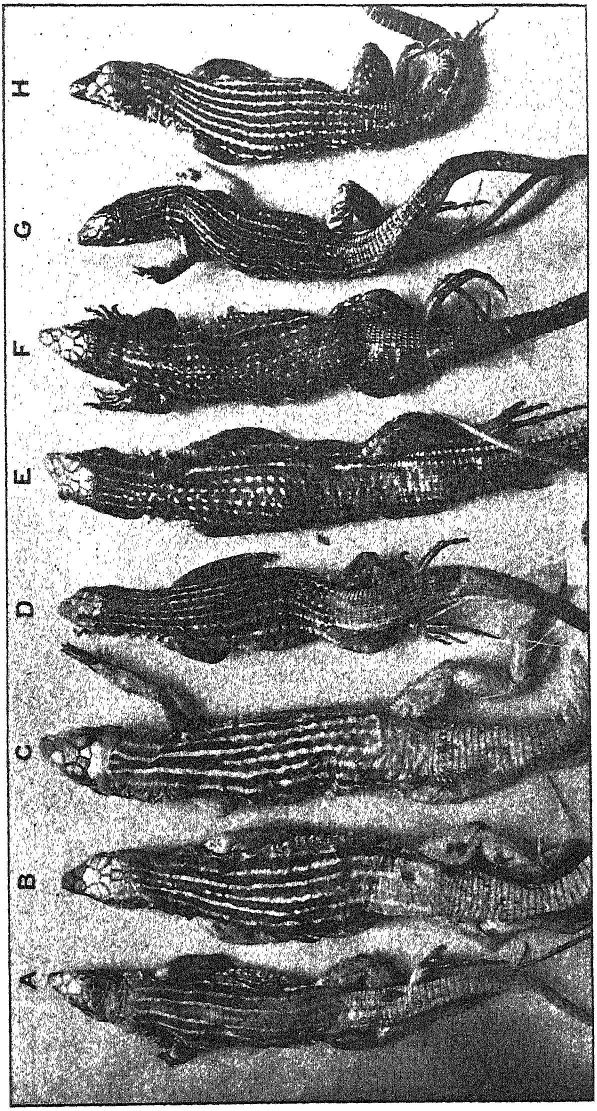
Chest and *belly* are whitish or greenish yellow; in the males more or less suffused with dark blue, chequered towards the sides and on the ventral surface of the thighs. But this blue, rarely verging towards black, is only suffused and is restricted to the deeper, cutaneous strata of the scales. The under surface of the tail is white, bordered or chequered with blue on the sides.

The colour-pattern of the back (text-figs. 74, 75, and 81 E) consists of an almost black to dark olive-grey to ashy-brown ground, broken by 6 to 9 longitudinal rows of white, slightly greenish or yellowish colour. These rows are either entire stripes, or one or all of them may be broken up into coherent beads, or into separate spots. This breaking up of the stripes into spots proceeds upon a definite plan.

First, the breaking-up increases with the size or age of the lizard, but this does not exclude the existence of old and large specimens which retain their stripes throughout life.

Secondly, the breaking-up, or the frequency of beads or spots, proceeds from the central stripe or pair of stripes towards the flanks. In this way then in the 7- or 9-striped specimens the central stripe, number 4 or 5 respectively, is the first to break up. In fact, there are none with 9 complete stripes, and there are but few with 7 complete stripes. Specimens with 8 complete stripes (the stripes 4-4 running parallel, or being joined into an unpaired one on the neck) are not uncommon, but more frequently they are dissolved into many white and bright spots. Then follows pair 3–3, then pair 2-2, which is often represented by a series of short streaks and beads. The last to break up is stripe 1; this often shows a tendency to become effaced from the neck backwards, so that, in many older specimens, it is represented by a short, somewhat dull line which extends from the hip forwards.

Text-fig. 74.

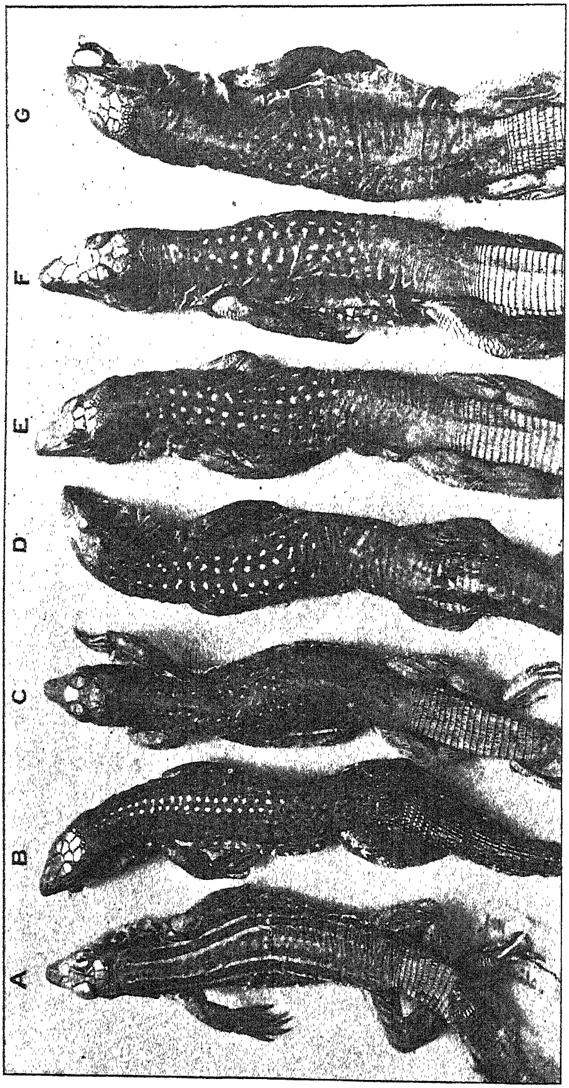


Cnemidophorus immutabilis.

A=Tequesixtlan 4, with 6 clear and a faint central stripe.
B & C= „ 1 & 3, with 7 stripes.
D=San Luis Allende 2, with 8 stripes.
E— „ „ 1, with 8 stripes, the 3rd and 4th pair broken up into beads.
F=Tierra Colorada 2, with 9 stripes.
G=Pacific to San Luis 1, with 9 stripes.
H=Cocoyul 2, with 8 stripes.

This first stripe, instead of being continued upon the front side of the thigh, as in *C. deppei*, is there represented only by a few

Text-fig. 75.



Cnemidophorus immutabilis and *C. guttatus*.

A = *C. immutabilis* from Salina Cruz 1, with an imperfect double row of central spots; with small 4th supraoculars.
B = *C. immutabilis* from Ayutla 8, with 8 complete rows of spots; with tiny 4th supraocular.
C = *C. guttatus* from Agua fria; with small 4th supraoculars.
D = ” ” ” Stripes 1 & 2 faint, stripes 3 & 4 broken into spots.
E = ” ” ” Stripe 1 faint, stripes 2, 3, & 4 broken into spots.
F = ” ” ” The spots of lines 3 & 7 are partly confluent.
G = ” ” ” Neck, shoulders, and rump becoming monochrome, the spots vanishing; with a tiny 4th right supraocular.

white spots; it reappears behind the thigh, to be continued along the tail, either as a white line or as an irregular series of spots.

Thirdly, the stripes have a tendency to break up first near the root of the tail or rump, and this feature proceeds forwards.

Fourth. The spots themselves can become effaced; this likewise proceeds from the rump forwards. In some very old specimens the rump and lower back are uniform dull, and all that remains of the 1st and 2nd pair of stripes are the pale greenish streaks which border the dull-black field I. above and below.

Fifth. These variations and changes are further complicated by the gradual appearance of pale, never bright, small spots in the dark fields, rarely in the black field I., often in fields II. and III., especially on the lower back. These additional field-spots give the lizards a much speckled and spotted appearance, if at the same time some of the stripes are dissolved into spots.

When I wrote the paper published in Proc. R. S. 1903, it was easy to distinguish between a striped and a spotted race; but during my second collecting-tour in 1904, in the State of Guerrero, I have brought together an ample number of specimens which completely bridge the two extremes. The important facts are, first, that the two varieties in their typical appearance are geographically distinct; secondly, that the intermediate kinds occur in those parts of Guerrero which geographically and physically are also intermediate.

The two extreme races are easily distinguished :—

I. *C. guttatus* of Wiegmann* is the large spotted race, in which the evanescence of stripes has reached its maximum.

The important feature of this dull-coloured race are the complete breaking up of the original 4th and 3rd pair of stripes into whitish-yellow spots, the breaking up or fading of the 2nd and 1st pair, and lastly the disappearance of nearly all the spots from the root of the tail forwards over the lower back.

These changes are gradual and proceed regularly with age. Old specimens show, moreover, partial confluence of neighbouring spots of the 3rd and 4th rows; a very interesting although slight indication of a combination into a transverse or cross-bar pattern.

In very young specimens, about 40–50 mm. in length, from Agua fria and San Juan Evangelista, all the under parts, including the collar, are still uniformly white. Lines 1 and 2 are still pronounced white stripes, although sometimes already broken into short streaks and fading towards the arm. The original stripes 3 and 4 are already dissolved into rows of about 25 small, pale dots, reaching from the neck to the tail.

Such typical *C. guttatus* are known only from the open forests with dense undergrowth, or similar patches of woodland, in the State of Vera Cruz and its confines with those of Oaxaca.—It has the priority of name; genetically it is the terminus of a series which begins with the entirely striped race:

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* Wiegmann's diagnosis, although not complete, is sufficient: "Cnemidophorus cineraceus guttis albidis in series 4 longitudinalibus dispositis, adspersus. Latera superne vitta lata, stria pallide viridi supra infraque inclusa, intense nigrescenti; inferne maculis multis pallidis adspersa. . . ."

II. *C. immutabilis* of Cope. By irony of fate this is the proper name of one of the most variable of lizards. It is what I called *C. guttatus* var. *striata* in Proc. R. S. 1903. Cope's types came from "West of Tehuantepec."

The characteristic feature of this brighter-coloured race is the 6 to 8 continuous white stripes on a rather uniform and dark ground.

Such typically striped specimens are now known from San Mateo del Mar, Salina Cruz, Tequesixtlan, Cocoyul and Pacific Coast east of Acapulco, Miahuichan, and southern slope of Los Cajones. In general terms: the coast region of the States of Oaxaca and Guerrero; how much further west along the Pacific Coast remains at present unknown.

I have found it exceedingly difficult to keep free from bias whilst assorting these very variable lizards according to the prevalence of either stripes or spots, and still more difficult clearly to pronounce upon the physical features of their localities. However, I can affirm the result that in the small open localities the striped lizards prevail, almost to the exclusion of more than two rows of spots; while in places with many shrubs, much underwood, absence of large grassy and sandy patches, the spotted forms prevail, in the more typical bush forests of the Atlantic side almost to the exclusion of stripes.

Open localities, either strips near the sea-shore, sandy beds of frequently dry rivers, grassy stretches with scanty trees, and nowhere covered during half the year with rank and dense herbaceous growth, were the collecting spots of Cocoyul, Salina Cruz, San Mateo, Tequesixtlan, San Domingo de Guzman; also Miahuichan, a spot on higher ground and just above the luxurious tropical growth of forests; likewise the open grassy slopes near Rincon at the southern slope of Los Cajones, amongst scanty pine-forests.

Much tangled underwood, broken terrain, well-wooded ravines, or meadows with tall grass and herbs, or rivers fringed with masses of shrubs, were the features of Tierra Colorada, Ayutla, and San Luis Allende; those very spots which yielded the most intermediate specimens.

In the Atlantic Tierra caliente, with its decidedly denser vegetation, with fewer deciduous trees, and much greater annual rainful, the typical *C. guttatus* alone is found, for instance at Agua fria, San Juan Evangelista, La Antigua (V.C.). Of course there are many and large Savannahs in the lower coast-districts of the State of Vera Cruz, and it would be interesting to ascertain whether any large *Cnemidophori* occur in the open Savannah, and not only in the vicinity of the typical clusters or patches of trees. Personally I have but little experience of these parts. All I can affirm is that I have seen no *Cnemidophorus* near Tetela, only *C. guttatus* at Agua fria, the same form and *C. deppei* at San Juan Evangelista (*deppei* within the sandy river-bed, *guttatus* in the wooded parts near the same banks), and *deppei* only at Juanita which lies within typical Savannah.

I consider it safe to affirm that *C. guttatus is an enlarged species of* C. deppei, *and that the striped or spotted condition of its upper parts depends directly upon the amount and character of the vegetation: stripes in the open, spots in the more bushy, shrubby, forest-like districts.*

Gularis-Group.

If we consider the great number of specimens, about 210, scheduled in the following pages, as one mass, their characters show such a great amplitude of variation that the diagnosis of the *gularis*-group becomes extremely vague.

Supraoculars 4.

Collar composed mostly of at least one row of large scales, but the edge may be formed by this row or entirely by granules.

Frenocular present or absent.

Size, from nose to vent from decidedly small to distinctly large, *i. e.* from 60 to 140 mm.

Humeral rows of scales from 3 or 4 or 5 to 8 or 9, either all large when there are but few, or some larger than the rest, or all small when there are many.

Posterior surface of the forearm covered entirely with granules, or, the other extreme case, with several long rows of transverse scutes or plates; every intermediate stage being represented, but the granular type is distinctly exceptional.

Femur with only 5 or 6 very regular rows, to as many as 8 or 9.

Front of forearm and tibia with 2 to 3, or even with a 4th row of scutes.

Femoral pores from 15 to 26, without a break between these rather rare extremes.

The same wide uncertainty applies to the pattern and coloration.

Under parts.—At least this can be said: the throat is whitish, often pink, never black; but from collar to vent the under surface may be whitish or yellowish, suffused with blue, or chequered blue and black and white, or entirely blue-black, at least in the males.

Upper surface.—All start with at least 6 pale stripes, and the mid-field may be divided by an unpaired centre stripe or by a 4th pair of stripes. The fields may have light spots, whitish or brown, or no spots.

The stripes may remain entire throughout life, or they may become ragged by confluence with neighbouring pale field-spots, or by encroachment of black field-spots; or the stripes may become dull and fade away unless new whitish, bluish or yellow spots develop within them.

The fields, originally dark, may remain spotless, or white, bluish or yellow or brown spots develop within them. These field-spots remain ill-defined, or they turn into round, separate spots; or two and two neighbouring spots in each field become confluent transversely, and this process, accompanied by active encroachment of the dark field-pigment upon the stripes (themselves fading away, or breaking up), may lead to a marbled, partly cross-barred, or completely tiger-barred transverse pattern. Lastly, a partly monochrome condition may gradually assert itself with advancing age, proceeding from the neck towards the back, or from the rump forwards, but with black spots upon the lighter ground-colour. Or the monochrome tendency proceeds from the neck backwards, and in this case the ground-colour is dark with pale spots.

Key to the Species &c. of the GULARIS*-Group.*

(Text-figs. 68 & 69.)

Small, less than 80 mm.	Stripes and pale field-spots persistent. North Mexico, Arizona, and Texas.	*gularis.*
Large, 100 mm. and more.	Stripes broken by the encroaching black of the fields.	
	Stripes broken on lower back. Few field-spots .... California.	*septemvittatus.*
	Stripes completely broken by the field black and by the transversely combining field-spots. Resulting in tiger-barred pattern .... South Mexico.	*mexicanus.*
	Stripes dissolved into rows of pale spots.	
	Fields with rows of spots.	
	Resulting in narrowly cross-barred yellow-and-black pattern .... Chihuahua.	*scalaris.*
	Resulting in many longitudinal rows of pale and round spots .... Mexico.	*communis.*
	Forearm with scutes or polygones.	
	5–7 humeral and femoral rows.	
	Chest and abdomen pale	var. *occidentalis.*
	,, ,, blue-black	var. *bocourti.*
	8–9 humerals and femorals	var. *copei.*
	Forearm entirely granular	var. *australis.*
	Stripes vanishing or cut up except the second. No field-spots. Collar black in adult. Tres Marias Islands.	*mariarum.*
	Uniformly olive, with 6 rows of black spots. Texas, Coahuila.	*semifasciatus.*

CNEMIDOPHORUS MARIARUM Günther.

Five specimens collected by Forrer on the Tres Marias Islands: 3 very young, one immature, one adult of 121 mm.

Supraorbitals 4.

Collar composed of rather weak scales, but of the type of the *gularis*-group; without granules on the posterior edge. There is a perceptible nest of somewhat larger granules on the throat.

Humerus with about 5 rows of larger scales, followed by a few of much smaller size.

Posterior side of forearm with a very large row of scutes, besides smaller scutes.

Femur covered with 7, 8 and 8 to 9 rows of scales, counting from the largest row to the pores; but there are several rows beyond the largest row, as is often the case in *Cnemidophorus*, and

Characters of the gularis-*Group.*

	Length. (mm.)	Locality.	Collar.	Humerus	Forearm.	Femur.	Pores.	Main features of Dorsal Pattern.
gularis	—80	North Mexico.	Large, no granules.	5–6	Scutes.	5–6–7	15–19	Complete persistent stripes and white field-spots.
septemvittatus	110	California.	Large.	6	,,	7	16–18	6 stripes partly broken by encroaching black of the fields.
semifasciatus	100	Coahuila—Texas.	Weak.	6	Polygones.	......	20	Monochrome olive with *dark* spots.
scalaris	—95	Chihuahua.	Moderate.	5–6	Scutes.	5 (6–7)	15–21	Numerous cross-bars of yellow and black.
communis occidentalis	100	Chihuahua to Jalisco &c.	Large.	5, 6, 7	Scutes or polygones (once granules).	6–7–8	16–21	Stripes break up into white spots. Ultimately about 10 rows of pale spots on back.
,, *copei*	—122 +	Colima. S. Domingo, Isthmus.	Large.	8–9	Scutes or polygones.	8–9	21–25	,, ,,
,, *australis* .	—130	Laguna, Isthmus	Large.	7–8	Granules.	7–9	22–26	,, ,,
	—140	Cuicatlan, Oaxaca	Variable.	7–9	Granules.	6–7–8–9	19–24	,, ,,
mexicanus	120+	Oaxaca.	Variable.	7–8	Variable.	6–7–8	16–23	Stripes fading. Black and pale tiger-bars.
	—109	Balsas Basin.	Large.	5–7	Scutes or polygones (once granules).	5–7	15–23	,, ,,
bocourti.....................	100	Oaxaca.	Large.	6	Scutes or polygones.	(5) 6	15–18	About 12 rows of yellow spots.
communis copei?	83?	Cozumel Island.	Weak.	6–8	Polygones.	6	21–22	
mariarum	120	Tres Marias Islands.	Weak, no granules.	8	Scutes.	7–9	19–22	No field-spots. 1 pair of stripes remaining. Mottled.—Collar black in adult!

counting these also the total sum would be 8 to 10 as stated by Boulenger, scarcely 10–12 as described by Günther.

Tibia with only $2\frac{1}{2}$ rows of scutes.

Femoral pores from 19–22.

Coloration.—Throat whitish yellow, with a faint blue tinge across the middle. Collar black in the adult! Chest and belly black with many white specks on the sides of the body. The thighs, legs, and the whole tail are uniformly reddish yellow in the youngest forms and in the immature; in the adult the thighs are blue-black and chequered with white. The preanal region is blue; the tail beneath is speckled dusky.

Upper parts (youngest forms): 3 pairs of thin stripes; mid-field broad and buff.

Immature: the 3rd pair of stripes is partly vanishing on the rump, so that field II. is merging into the buff of the mid-field.

Adult: the first pair of stripes begins to be cut up by the encroaching black of field I. and by the black of the lateral field. The result is a light brown or buff ground-colour, with only one pair of pale stripes, and mottled with black on the sides of the body.

The absence of light spots in the fields and in the vanishing stripes constitute a remarkable pattern in this large and completely isolated kind of lizard.

CNEMIDOPHORUS GULARIS Baird.

The collar is composed of several rows of large scales, and the posterior margin of the collar is formed entirely of large scales, without granules. The posterior side of the forearm is covered with one or more rows of large polygones or scutes, instead of granules; 6 pale stripes persist as unbroken lines. The dark fields are at first spotless, but soon a row of pale, mostly whitish spots appears in the first and second fields, without breaking up these fields (text-figs. 69 & 70).

It is not easy to abstract a satisfactory, further definition from Cope's writings of what he understood by his *C. gularis gularis*. The femoral scales are said to be in 6–8 rows. The femoral pores are stated, in the key, to vary from 18–23, but in the text specimens with less than 16 are mentioned. The frenocular "occurs occasionally." The chest of the males is black, while the scales of the belly are margined with black; there are light spots on the flanks below the first stripe.

Amongst an apparently large number of specimens from Chihuahua Cope mentions some, distinguished by him as *C. g. gularis obsoletus*, with wider and very obscure stripes, and with small obscure spots in the fields. Some of these specimens were the largest of the collection. In others, including "a good many small specimens," the stripes were wider, and the field-spots enlarged so as to be confluent occasionally with the light stripes.

The size of these lizards is not mentioned, except that "the size of the adults exceeds a little that of the Eastern form [*C. sexlineatus*], a specimen from Arizona measuring 100 mm. This is, however, larger than the average."

According to Cope, *C. gularis gularis* is found in Western Texas, New Mexico, and Arizona, and in Mexico as far south as Chihuahua and Monterey. A locality almost at sea-level is Matamoros, near the mouth of the Rio Grande. Cope mentions it especially as inhabiting the Staked plains of Texas. Tucson and Fort Lowell in Arizona, Chihuahua, Monterey, are all situated in flat, practically treeless plains.

Only a few specimens examined by myself agree with the typical *C. gularis gularis*. They are the following:—

I. *British Museum*: 6 specimens from Fort Lowell, Arizona, and from Duval County, Texas.

	Length. (mm.)	Collar.	Forearm.	Pores.	
Fort Lowell (2).	77	Row of large scales.	Large polygones.	...	Numerous sharp white specks in the stripes, indicating change towards *C. communis*. Field-spots.
Duval Co., Texas.	62	Edge formed by row of granules.	Enlarged polygones.	15	Faintest field-spots.
„	67	Larger scales.	Large scutes.	18	3 pairs of stripes and subdivided mid-field. Field-spots.
„	65	„	„	17	4 complete pairs of stripes. Brown spots in fields I. and II.
„	Very young form.	„	„	...	Already with 4 pairs of stripes, 4/4 enclosing an island.

II. *One of four specimens, taken by Dr. Meek at San Juan*, south of Monterey, agrees with the typical *gularis*, and contrasts considerably with the three others in size and arm-scaling. It is a female of 72 mm. Without frenoculars. Posterior surface of forearm with a short row of large scutes. Femoral rows 6. Pores 17. Throat and collar pink. Chest and abdomen white, suffused with bluish green. Upper surface with 7–8 pale stripes; the normal three pairs being white, but the mid-field is sharply marked by a black band against the median side of each third stripe, and the resulting grey central region is imperfectly divided by a row of black dots in the mid-line. A row of rather large, but ill-defined pale spots in the first and second fields. The posterior thigh-stripe is partly broken.

This specimen indicates, by the pink throat and by the subdivision of the mid-field 3–3 into a 4th pair of stripes, a tendency which becomes preponderant in the lizards which are found to the south of the home of the typical *gularis*.

It is important to note that San Juan lies close to, and between, Monterey and Montemorelos, from both of which places some of Cope's *C. gularis gularis* are said to have been received; and that he mentions Monterey specimens as having the low number of pores. To judge from the specimens described below, it seems to me that this is the critical district in which the change from the typical *gularis* into the slightly more southern var. *meeki* is taking place. This can be settled definitely only by examination of the specimens in the Smithsonian Institution.

The following specimens I distinguish as *C. gularis*, var. *meeki*:—

Two specimens from Montemorelos, collected by Dr. Meek.—One 62, the other (male) 65 mm. in length, agree in coloration and pattern with the typical var. *meeki*, but the collar is distinctly weaker, the scales decreasing rapidly towards the sides. There is only a nest of moderately large scutes on the forearm; the scutes being distinctly less developed than in the San Juan specimens. Humerus with 6 rows of scales, all rather large. Femoral rows 5 to 6 irregular in one, 6 to 7 irregular in the other. ♂ with 16/15, the smaller specimen with 19/20 pores. The frenocular is present in one, absent in the other.

Six specimens from Garza Valdez, collected by Dr. Meek.—60–75 mm. in length; two females with eggs measure 64 and 68 mm. Consequently a decidedly small kind of lizard.

Frenoculars present in 3, absent in 3 specimens.

Collar composed of large scales, except in one specimen in which the scales are rather small; rarely with a few scattered granules on the posterior edge.

Humerus with only 5 or 6 rows of scales, which, in conformity with their small number, are all rather large.

One or two of the last rows are continued upon the forearm's posterior side.

Forearm: front with 2½, rarely 3 rows of scutes. The posterior surface is covered with at least one row of very large scutes.

Femur with 6 rows of scales, of which three extend down to the knee.

Tibia with 3 rows of scutes, with sometimes a small fourth on the fibular side.

Pores: 4 specimens with 15/16, one with 17/18, one with 19/19.

Coloration of under parts: Throat bluish white in young and in females; in males with a pink tinge and faintly mottled with bluish pigment on the sides. Collar white, but mottled on the sides in the males. Chest and abdomen in young and females white, suffused with bluish on the sides; this suffusion increases in males first on the chest and then spreads backwards, until in the old males all the under parts inclusive of the arms and thighs are uniform black. Under surface of tail and tibia uniformly yellowish white.—Upper surface with 3 pairs of white or bluish-white stripes. The fields are nearly black, with rather faint bluish or whitish spots in the first and second fields. The mid-field 3–3 is bordered by black bands enclosing a grey centre, which is more or less clearly subdivided by a darker central line, so that in all 7 or 8 pale stripes can be counted. In the oldest male the first stripe is broken up into a row of bluish spots owing to the black of the bordering fields joining across the stripe; an arrangement which leads on the sides of the thorax to the formation of imperfect black, short cross-bars. In this respect this old male agrees with the old male from Lerdo, *q. v.*

Two specimens from La Cruz, collected by Dr. Meek (63 and 76 mm.).

Frenoculars present in one, absent in the other specimen.

Collar composed of large scales, in the younger with granules on the sides of the edge.

Humerus with 6 rows, the fifth continuous across the elbow with the main long row of much enlarged scutes of the forearm.

Femoral rows 5, all unusually large, three of which continued to the knee.

Tibia with 3 rows of scutes, and in the larger specimen with a small fourth row.

Pores 15/16 and 17/18.

Colour of under parts: Collar and throat flesh-colour to pink, sides of collar slightly mottled. Chest, abdomen down to the last ventrals and anus blue-black; the same colour, but somewhat mottled on the thighs. Behind the thigh a white stripe.

Upper parts: 3 pairs of bluish-white stripes and rather faint pale spots in the almost black fields. Mid-field 3–3 bordered by black bands enclosing a fourth pair of grey stripes, which are separated by a ventral streak, or row of black specks, indicating in all 8 stripes.

Three specimens from San Juan, collected by Dr. Meek (57, 58, and 59 mm.).

Frenoculars present in all.

Collar composed of larger scales.

Humerus with 6 rows.

Forearm with enlarged scutes, none of which reaches beyond the proximal half of the arm.

Femur with 5, 6, and 7 rows.

Tibia with 3 rows and a small 4th on the fibular side.

Pores 16 in all specimens.

Throat pink, collar yellowish or mottled on the sides. Chest and abdomen black, gradually changing to flesh-colour towards the groins, which is also the colour of the preanal region of the whole under surface of the hind-limbs, tail, humerus, and forearm.

Upper parts very dark, the fields I., II., and III. being nearly black, with only one row of faint pale spots in the first two fields. On the back are 8 pale bluish stripes, the third and fourth pairs being dull grey and the latter pair divided by a black central line.

There is no doubt that the 13 specimens from Montemorelos, Garza Valdez, La Cruz, and San Juan are closely allied to each other, and differ in the average from the typical, Northern, *C. gularis gularis* by their larger forearm-scutes, small number of rows of scales on the humerus and femur, the small number of pores, the pink throat and decidedly strong and uniform black pigmentation of the chest and abdomen, and lastly the tendency to develop a 4th pair of pale stripes in the mid-field besides the usual 3 pairs. I therefore distinguish this small race as *C. gularis*, var. *meeki*. In favour of its claim to distinction is the fact that this combination of characters does not occur elsewhere but in North-eastern Mexico.

CNEMIDOPHORUS SEMIFASCIATUS Cope.

Based by Cope upon three specimens, one from San Diego, Texas, and two from near Patos in the State of Coahuila, west of Monterey.

Cope gives the following definition: No light stripes; olivaceous with three rows of black spots on each side on anterior fourth of body; femorals 8 (but 6 in the text and in the figure!); limbs unspotted; medium size.

To judge from his description and the figure in the text, the collar is but feebly developed, although the scales are larger than in the *tessellatus*-group. Humeral scales in 6 rows. Postantebrachials with enlarged polygones in 3 or 4 rows, all distinctly small in the figure. Femoral pores 20. Length 100 mm.

The colour of all the under parts is uniform olivaceous, without any spots. The upper parts are uniform olivaceous with the following black marks: three rows of black spots on each side; the superior small, subquadrate; the second larger and transverse, the inferior forming short cross-bars. The lower row is the longest; the upper is the shortest, extending only to the middle of the trunk.

These two specimens from Coahuila are interesting as showing that a race of Lizards belong to the *gularis*-group has reached the light-coloured monochrome stage with black marks or spots, which, being the remainder of the originally dark fields, are themselves reduced from behind forwards. This race therefore forms an analogon to the var. *rubida* of the *tessellatus*-group (text-fig. 70).

If, as Cope himself suggested, the solitary specimen from San Diego, Texas, described by him as *C. gularis sericeus*, is the female of *semifasciatus*, we can follow the coloration of the latter a stage further back. The specimen measures only 81 mm. Throat, limbs, and tail "yellow," with a bluish patch across the throat; chest and belly bluish olivaceous. Ground-colour above anteriorly black, posteriorly olive. With 7 paler stripes which fade away towards the rump. The fields are black, with olive spots anteriorly, which enlarge further back, breaking up the fields. Pores 21.

It may be accidental, but in all these three specimens the 4th supraoculars are broken up each into two smaller scutes:

C. semifasciatus with, *C. sericeus* without frenocular. The distinctly feeble collar, only polygones on the forearm, and the high number of pores, combined with the peculiar dorsal pattern, justify us to treat these specimens as a distinct subspecies, especially since they differ so remarkably from the other kinds of *Cnemidophorus* of closely neighbouring districts, e. g., *C. melanosthetus* of Parras, *C. gularis gularis* and var. *meeki* of Monterey, &c.

CNEMIDOPHORUS SEPTEMVITTATUS Cope.

Based upon one female specimen from Eldorado County, California. Length 110 mm., which, for a female, indicates a very large kind of *Cnemidophorus*.

Supraoculars 4. Collar composed of large scales. Humerals in 6 rows. Posterior side of forearm, according to figure, with 5 mostly very large scutes in a row, surrounded by granules. Femorals in 7 rows. Pores 16/18.

Coloration.—Under parts all yellowish, with a few black specks on the sides of the throat. Upper parts light olivaceous brown, with 7 longitudinal broad black stripes, three on each side and one in the middle, &c. From Cope's long description I gather the following, if translated into the language employed in the present paper:—There are 6 pale stripes, separated by black fields and a black mid-field. Towards the lower back and upon the rump the stripes 2 and 3 are broken into spots by the gradual encroaching of the black pigment from the neighbouring fields, which themselves have but few and small field-spots, restricted to the anterior half of the body.

To judge from this solitary specimen, it seems to belong rather to the *C. communis* of the *gularis*-group.

CNEMIDOPHORUS SCALARIS Cope. (Text-figs. 68 & 76.)

19 specimens from Chihuahua, near the City. Field Museum of Natural History.

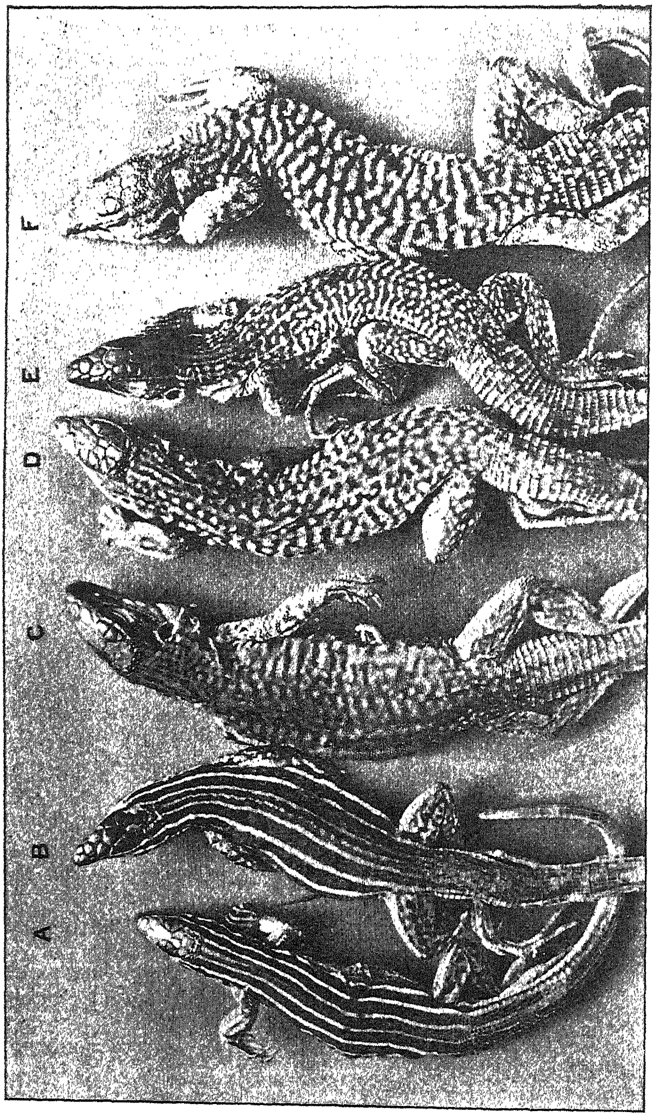
Length 50–95 mm.; 95 mm. only one male, while three or four other males come near 90 mm. This is consequently a small and slender species, inhabiting the arid plains with their sparse vegetation of Mesquite and Fouquieria shrubs, Yuccas and Opuntias. Hitherto recorded only from Chihuahua.

Supraoculars 4, mostly with only one row of elongated granules behind.

Collar sharply marked and composed of moderate scales. In only one specimen is the posterior margin of the fold formed by a complete row of granules, while in one other the granules are restricted to the lateral third of the collar.

Humerus.—3 or 4 large rows of scales cover the front, then follow 2 or 3 shorter and somewhat smaller rows; about 6 in all, or only 5, in which case the first or first and second rows are extra large. But 8 rows cannot possibly be counted in these specimens, as stated by Cope for his *scalaris* from Chihuahua.

Forearm, anterior surface, with mostly 3 complete rows of scutes, of which the outermost row increases in width of the scales towards the wrist, while the innermost row is composed of much smaller scales.



Text-fig. 76.

Cnemidophorus scalaris from Chihuahua; Field Museum of Natural History.

Forearm, posterior surface, always covered with much-enlarged scutes, the largest in the middle, reaching towards the wrist; on the elbow continuous with the 6th or 5th, rarely with the 4th row of humeral scales.

Femur: Mostly with 5 very regular rows, rarely with 6, which are then rather irregularly disposed; the three largest rows reach the knee as in *C. deppei.* One specimen, 60 mm., has 7 unmistakable rows; another of 50 mm. has 7 incomplete right and 6 regular rows on the left thigh.

Tibia covered with 2 very large rows, with a third smaller row on the fibular side, *i. e.* the side turned towards the tail.

Preanal isthmus short, with only one or two transverse rows of small scales between the ventrals and the preanal plates. The detail is very variable.

Femoral pores: From 15/17 once, to 21/21 once. Usually with 17, 18, or 19 rows; 20 did not occur. The solitary occurrence of 21/21 refers to a specimen 60 mm. in length; the only one possessing 7 femoral rows of scales, and further distinguished by the almost complete absence of pale spots in the black dorsal fields.

Coloration and pattern.—Under parts of young white and mother-of-pearl; immature specimens have the chest and abdomen suffused with pale bluish, and dark pigment appears in the basal portion of the scales. In the adult, throat, collar, thighs, and tail are yellowish white; chest and flanks, less so the belly, are mottled blue-black, the edges of the scales remaining whitish.

Upper surface (figs. 68 & 76). The young start with 6 sharp white stripes, with single or double rows of pale spots in the fields, and also with a row of white spots in the middle line. In specimens of about 70 mm. the stripes have become dull to pale grey, with small white dots in the dulled stripes. Field-spots brown, yellow, or brown-yellow, and more numerous, and their double rows in each field become confluent. Ultimately the stripes are lost, remaining traceable longest on the neck; the whole back is covered with numerous cross-bars or vermiculations of deep black and vivid yellow, or orange, with many white spots on the thighs, legs, and rump. In some beautiful specimens the tiger-bar pattern is complete, there being about 30 black cross-bars from nape to tail; whilst the back approaches the cross-bar stage, the white stripe on the hinder surface of the thigh is dissolved into irregular white spots.

C. scalaris is known only from near Chihuahua town, and plateau to the south of it, except two specimens "from Arizona" according to Cope.

According to the evolution of the pattern from youth to adult age (for instance, the very pronounced white spots in the stripes), this lizard is closely allied to *C. communis.*

CNEMIDOPHORUS COMMUNIS Cope.

Diagnosis.—4 supraoculars. Collar strong, composed of at least one complete row of large scales which form the edge; upon this follow, towards the throat, several shorter rows of scales which decrease in size. Posterior surface of forearm with at least some large scutes. Frenocular variable. The young start with from 6 to 8 whitish *stripes, which become dull, whilst white spots develop within most of these stripes.* Fields at first dark, later on light spots develop in them, mostly rounded and well-defined. *Ultimate result*: many spots on very dark ground in about 10 longitudinal rows, and numerous small whitish spots on the rump, root of tail, and on the thighs. Throat and collar light-coloured, often pink. Chest and abdomen are early suffused with blue; with advancing age chequered blue and black, with whitish edges to the scales.

Cope was quite justified in separating Mexican *Cnemidophori* of larger size, with essential *gularis* structure (4 supraoculars, strong collar, and large forearm scutes), and in which the stripes break up into rows of spots, as *C. gularis communis*; but he did not know, or he ignored, *C. bocourti*, and he had only a very insufficient Mexican material.

The diagnosis or description given above suits the majority of those *Cnemidophori* which are known from the western half of the Mexican plateau and its western and south-western slopes, from the north-west of Chihuahua to Colima and Manzanillo; and across the plateau from, roughly speaking, Guadalajara to Guanajuato and Puebla. But in this wide stretch of varied country they exhibit considerable changes,—changes which at first crop up as unimportant, individual variations, but which in neighbouring districts have become the rule; and to these are added changes of other characters, until their combination completely upsets the original diagnosis.

Thus, for instance, in Michoacan the stripes are more persistent and the scutes of the forearm are more polygonal, smaller, even reduced to granules. In Colima, the pores and the rows of scales on the humerus and femur are distinctly more numerous. At Manzanillo, these changes are combined with smaller collar-scales; while on the Isthmus of Tehuantepec and in Oaxaca, at Cuicatlan, an entirely granular forearm is added; so that nothing is left which could justify us to enumerate these specimens as a subspecies or a race of *C. gularis*, whilst they could well figure as a race of *C. communis*. At the same time, they approach the less typical specimens of *C. immutabilis* and *C. guttatus* to such an extent, that it is not always easy to keep them asunder.

Further, in the basin of the Balsas River *C. communis* is represented by a form which is structurally an intensified *C. gularis*, and removed as far as possible from the southern variations, but the spotty character is gone, and the tendency to destroy the stripes by cross-bars begins to assert itself, until further east, in Oaxaca, the old specimens are tiger-barred with a variable, partly granular collar and with smaller and fewer scutes on the forearm. These are *C. mexicanus*, which may well be called *C. gularis mexicanus*, in opposition to *C. gularis communis*, but not possibly could it be named a race of *communis*.

Lastly, on Cozumel Island, off Yucatan, *C. communis* reappears, so that we may infer its occurrence in Yucatan.

CNEMIDOPHORUS COMMUNIS OCCIDENTALIS. (Text-figs. 69, 77 A–F, 78 B, 79 A.)

Diagnosis.—4 supraoculars. Strong collar. Posterior side of forearm with scutes or enlarged polygones. Stripes broken up, in the adult, into rows of round spots; fields with similar rows of spots. Humeral rows of scales 5–7. Femoral rows 6–7, mostly 6. Pores 16–21. Length rarely exceeding 100 mm.

Range the same as that of the Sierra Madre occidental, from N.W. Chihuahua to Jalisco.

Specimens from Ixtlan differ considerably in their colour-pattern, approaching thereby *C. mexicanus* of Oaxaca—a very significant case of convergence.

On the Central plateau *C. communis* seems to remain somewhat smaller, with less emphasised characters in coloration; but it reappears intensified at Puebla. Such an extension across the country, from Jalisco, across Guadalajara towards and beyond Guanajuato and Queretaro, conforms well with the physical features of the country; and in my paper on "The Distribution of Mexican Amphibians and Reptiles," Proc. Zool. Soc. 1905 (vol. ii. p. 191), I have been able to show the existence of such an exchange. Whether these *Cnemidophori* ascended through this Jalisco gap, or descended thither from the plateau and from the bases of the Western Sierra Madre, is another question.

Lake Santa Maria (text-fig. 78 B) in N.W. Chihuahua.—The single specimen is remarkable for having only 3 supraoculars on the left side, whilst the 4th right is very small. The collar consists of only one row of scales, which are rather small, and nearly all of the same size. The posterior surface of the forearm shows three rows of large polygones, none of which can be called large scutes. The other structural features likewise afford no decided clue to the affinity of this specimen. Throat and collar are white, with a bluish tinge across the mid-throat and across the collar excepting the row of larger scales. Chest and abdomen white, with bluish bases to some of the scales. Tail, hind and fore limbs, and anal region are white beneath. The upper surface is uniformly slaty grey, rather dark, with many small whitish specks, especially on the lower back, rump, thighs, and root of tail. Of the original stripes, only faint traces of stripes 1 and 2 are still visible.

The dusky band across the collar and the small whitish and bluish dorsal spots undoubtedly point to the relationship of this specimen with those of Tuxpan (text-fig. 79 A).

Durango, from the foot of the Iron Mountain, on rather barren ground (text-fig. 77 C).—Supraoculars 4. Collar composed of large scales, mostly with an imperfect, once with a complete row

C. communis occidentalis.

Locality and number of specimens examined.	Length. (mm.)	Frenocular.	Humeral rows of scales.	Posterior side of forearm.	Femoral rows of scales.	Pores.
Lake Santa Maria, N.W. Chihuahua. Dr. Meek. 1.	92	None.	5 rows in all.	Large cluster of 3 rows of large polygones.	6. ……	21/21
Durango Dr. Meek. 6.	Largest 88, 97.	……………	Mostly 6. In 2 specs. 5th & 6th very short; 1 with 8 rows.	One long row of large scutes.	6; only 1 sp. with 5–6.	15/16–19/17
Lerdo Dr. Meek. 2.	63, 90	None.	6, first and second very large.	One long row of large scutes.	7, and 8 very irregular.	17/18, 18/18
Presidio Brit. Mus. 6.	55–85	3 with, 3 without.	6–7 in all.	5 with large scutes. 1 with large polygones.	6, 7, 7.	17, 18, 18, 20
Sierra de Nayarete, Tepic. Brit. Mus. 5.	85–98	1 with, 4 without.	3 large rows followed by 4 or 5 small.	With one or more rows of large scutes.	5–6, 6, 6, 6–7, 7.	18–20
Ixtlan, Jalisco Brit. Mus. 11.	Smallest 58, 3 largest 100.	6 with, 3 without. 1 on one side only.	………………	………………	6. ……	17–22
Zapotlan, Jalisco Dr. Meek. 2.	100, 100	None.	6–7.	Long rows of large polygones or of large scutes.	6. ……	19/18, 20/19
Tuxpan Dr. Meek. 1.	108	With.	3 large, with 3 or 4 small.	Large rows of scutes.	7. ……	20/21
Patzcuaro, Michoacan Dr. Meek. 3.	65, 88 Gravid 71.	None.	2 with 5 rows, 1 with 4 rows.	1 with a nest of enlarged round granules. 1 with a nest of polygones. 1 with several rows of large scutes.	…………… 6–7. …… ……………	17/19 18/18 16/15
Guanajuato Brit. Mus. 6.	48–88	None.	4 large rows followed by 1 or 2 smaller.	Scutes or enlarged polygones.	6–7. ……	16, 17, 18
Puebla Dr. Meek. 9.	Largest 100, 102, 105, 110.	4 with, 4 without, 1 on one side only.	3 with 6; 5 with 7; 1 with 8 rows. One or more of the first rows always much larger.	2 with a nest of enlarged polygones. 1 with a nest of large polygones. 6 with one or more rows of large scutes.	Mostly 6 rows. 2 with 6–7.	16/16–19/19

of granules at the hinder edge. Posterior side of forearm with large scutes in at least one row.—Consequently these specimens combine the intensified features of the *C. gularis* group.

The immature have 6 clear whitish stripes, and faint brownish spots in the very dark, almost black first and second fields. The centre-field 3–3 is also black, with a short white centre streak on the nape and neck, and this streak is in one specimen continued upon the back by a double row of pale spots; in another it is continued as a dull unpaired stripe. These variations demonstrate the possibility of 7 to 8 stripes in all.—In the 88 mm. specimen all the stripes are reduced to faint lines on the neck. The rest of the back shows a uniformly black ground with numerous whitish spots in about 10 rows; the thighs are similarly spotted.

In the oldest specimen (97 mm.) the ground-colour is very dark, blackish, with numerous, very conspicuous white and bluish round spots in 10 or 11 rows. The three pairs of stripes are faintly visible on the neck, where the spots are far less pronounced. Throat and collar are pink. Rest of under parts, including the arms, blue-black, mottled with particoloured scales. Tail bluish beneath.

This 97 mm. specimen much resembles a 90 mm. specimen from *Lerdo*, near Torreon; this town would, with our present state of knowledge, represent the North-eastern limit of the typical *C. communis*.

The collar of the *Lerdo* specimens is composed of large scales, without granules. Throat of the adult red-pink; sides of collar grey. Rest of under parts, including thighs, blue-black with whitish scale-edges. Tail bluish.—Above: the smaller specimen with 6 complete stripes and a pale centre-line. Double rows of grey-brownish spots in the dark fields. In the larger specimen the stripes have disappeared completely; ground-colour black, with numerous bluish-white spots, arranged in rows, from neck to tail. Sides of trunk with black and light bars, some of which reach far upon the back.

Ixtlan.—The specimens were collected by Dr. Buller near the River Santiago, near the confines of the State of Jalisco and the Territory of Tepic, at altitudes from 1500 to 3500 feet. This district is sandy, rather tropical, and produces much vegetation. It is remarkable that none of these specimens belongs to the essentially spotted-colour variety, but ends in the partly cross-barred type.

The evolution of the dorsal pattern proceeds as follows:—They start with 6 to 8 pale stripes and black-brown fields. Pale, light-brown spots in one or two rows appear in all the fields, proceeding from behind forwards. Against the inside of the third pair of stripes appears a double series of blackish spots. Stripes 2 and 3 become dull, and within each of these stripes appear, or remain, white spots. The field-spots become pale, buff or whitish, and then they become transversely confluent within each field. Ultimately alternate black and whitish cross-bars are produced, which, reaching from the flank through stripe 1, through field I., through stripe 2, cause a cross-barred appearance. This procedure much resembles that of the typical *C. mexicanus*.

In opposition to the essentially spotted variety of *C. communis*, the Ixtlan specimens retain a fair amount of their stripes. For instance, in the largest specimen the fourth pair is still retained; but the first and second stripes are mostly dissolved into white spots, in the way characteristic of *C. communis*.

The throat is white, sometimes pink, or even with a strong brick-reddish tinge; collar whitish; body in the adult chequered, especially on the flanks. The thigh-stripe breaks up early. Tail beneath either reddish or bluish.

Sierra de Nayarete.—Dr. Buller collected the five specimens in Ranchos, in the walls of corrals, on the eastern side of the Sierra, at an altitude of about 4600 feet, apparently in open, treeless surroundings. These are the specimens referred to in my paper (Proc. Roy. Soc. 1903, p. 118) under *C. bocourti*, and as aberrantly coloured; but they belong undoubtedly to the *C. communis*. Supraoculars 4; collar composed of large scales; forearm with typical scutes.

There is much individual variation in these few, probably all adult, specimens:—

85 mm. Stripes 1 and 2 broad and conspicuous, white; stripe 3 narrow and complete; 4th pair narrow, somewhat zigzag, enclosing a black centre-field. The fields are black-brown, with very faint red-brown spots. There is an extra white line below stripe 1, extending from the ear towards the thigh! Throat and collar pale, yellowish, with dusky mottling! Chest and belly still yellow. Tail bluish beneath.

93 mm. Stripe 1 is nearly gone; stripes 2 and 3 are being dissolved into whitish spots; the 4th pair is still complete. Fields with large round yellow-brown spots in double rows. Throat and collar yellow, much mottled with black! Chest, belly, preanal region, and thighs yellow, chequered with black.

97 mm. Stripe 1 is lost, stripe 2 much broken up; stripes 3 and 4 still present. Large pale brown spots in the fields. Throat and collar mottled black and yellow! Rest of under parts with much black and blue pigment, chequered with yellow. Tail bluish black.

98 mm. Stripes 1 and 2 are quite gone; only narrow traces of the others. With about 10 rows of large round yellow spots on a uniformly black ground. Under parts like the 97 mm. specimen.

98 mm. The 6 stripes are still well preserved, but getting dissolved into white spots. Two rows of pale spots in the blackish first and second fields. The broad, unicoloured mid-field is bordered by black dots. General ground-colour olive-grey. Throat and collar yellowish white. Chest and belly much pigmented with black and blue. Tail red.—This male specimen was caught at a different rancho, and it is distinguishable from the previous four specimens by the presence of a frenocular, a very unimportant character.

Presidio, south-east of Mazatlan in Sinaloa.—Presumably the

6 specimens collected by Forrer are related to the Tepic and Jalisco *Cnemidophorus*. They possess 6 white or whitish stripes, with faint field-spots which increase in number with age. There is no trace of a fourth pair of stripes, and no breaking-up of the stripes into spots is indicated, not even in the largest specimens. The throat is sometimes speckled with dark pigment; chest and abdomen are chequered blue-black and white. The tail is reddish beneath.

Zapotlan in Jalisco, between Guadalajara and Colima. (Text-fig. 77 A.)—Throat across the middle with a dull bluish tinge; lower throat whitish, and mottled with grey. Collar bluish, except the large row of scales which is white. Upper chest blue with white edges to the scales. Rest of body black, chequered with white. Tail beneath very dark, all the whitish scales having much blue-black pigment. Under surface of arms blue-black with whitish patches.—Upper parts:—First specimen: 6 complete dull stripes; mid-field dark grey, bordered on each side by a row of black spots. Fields I. and II. black, with irregular rows of large, round, grey spots. None of the stripes is dissolved into spots, but whiter spots are visible in the second stripe.

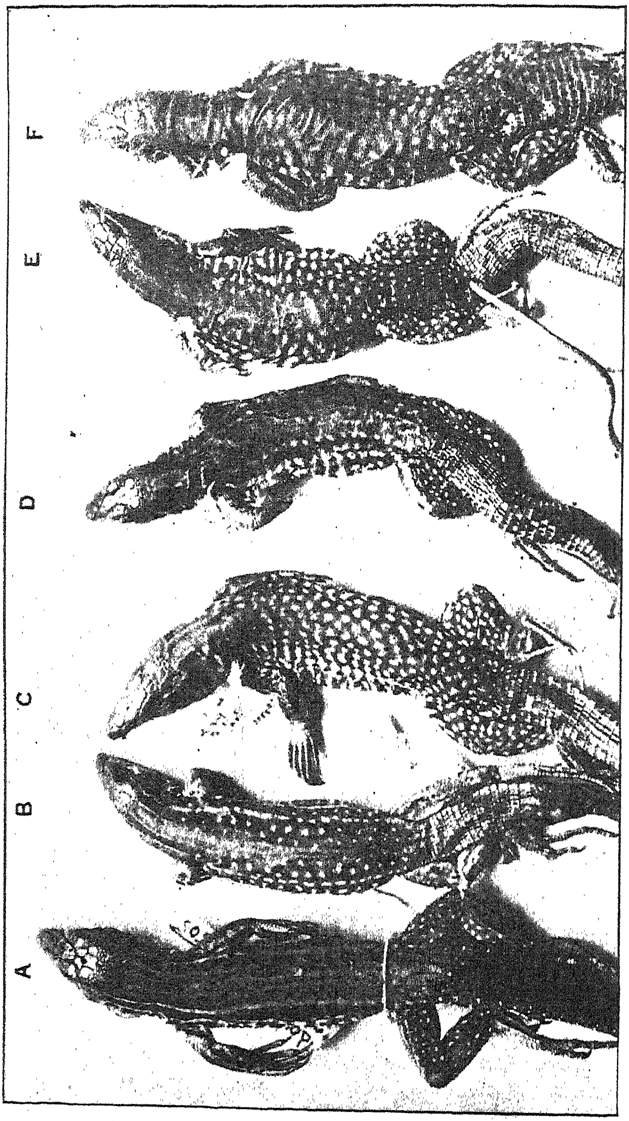
The second specimen is beautiful. There are no traces of stripes left. Neck and shoulders are dusky. The whole back shows about 10 rows of large round yellowish-white spots upon a dark ground. Smaller yellow spots on the rump, thighs, legs, and upon the first two inches of the tail. On the sides of the chest the black colour forms cross-bars because the rows of large pale spots below the first stripe are transversely confluent. This specimen conforms exactly with Cope's typical *C. communis*, whilst the first, also a male, scarcely shows the characteristic development of spots within the stripes. Unfortunately I did not catch a single specimen at or near Zapotlan, but I saw several in the striped and in the spotted condition.

Tuxpan (text-fig. 79 A), south of Zapotlan.—Fourth supraocular very small. Throat tinged with bluish across the middle; collar bluish white. Rest of under parts, including arms and thighs, dark blue with some white specks on the flanks. Tail blue all round. The ground-colour of the upper parts olive-brown, with 6 dull stripes, each of which is broken up into whitish beads. The first and second fields with conspicuous black cross-patches. Mid-field olive-brown, with a few small black specks along the inside of the third pair of stripes. Numerous small, whitish spots on rump, thighs, and tail, and a few such spots in the second field.

This specimen, having lost most of the small white spots on the back, in conformity with the prevalence of olive-brown ground-colour, is in the incipient tiger-stage, connecting in this respect the Colima specimen (*C. communis copei*) with the 88 mm. specimen from Patzcuaro (text-fig. 77 B).

Puebla. Nine specimens collected by Dr. Meek near the town of Puebla on the railway embankments.—Throat and collar white or pink. Chest and belly white, and chequered with blue owing to the dark bases of the scales. Tail beneath yellowish white.

Text-fig. 77.



Cnemidophorus communis occidentalis; Field Mus. Nat. Hist.

A = from Zapotlan.
B = from Patzcuaro.
C = from Durango, the most conspicuously spotted specimen.
D, E, F = from Puebla.

Immature with 6 stripes, of which the third pair is dull and narrow. Pale faint field-spots appear late. Then whitish spots appear in the evanescent stripes and produce a spotted stage with many, about 10 or more, rows of whitish-blue spots, especially numerous on the lower back, rump, and thighs, upon a very dark ground. In large and old specimens the ground-colour becomes olive-grey, with bold transverse black tiger-bars across the middle of the trunk; the white stripes and spots having changed completely into grey. The black pigment encroaches upon the breaking-up stripes, and the neck of some old specimens tends to become monochrome.

There is no doubt that this clan of rather large-sized Lizards conforms more with *C. g. communis* than with *C. c. balsas*. It is all the more interesting that these Puebla lizards come to resemble the more or less tiger-barred specimens of *C. c. balsas* (which are probably their neighbours) if they pass beyond the white-spotted stage.

Patzcuaro (text-fig. 77 B), south-west of Morelia, in Michoacan. —The smallest specimen with 6 complete stripes and a broad mottled mid-field. In the gravid female and in the adult male the stripes are broken into streaks or numerous spots, bluish-white and similar spots have appeared in the fields. Chest and belly suffused with blue owing to the underlying dark pigment.

Acambaro, north-east of Morelia. Only one immature specimen, collected by Dr. Meek.—Still with 6 very sharp, white stripes; pale spots just appearing in the outer and in the second fields.

Celaya, north of Acambaro, west of Queretaro: 4 specimens collected by Dr. Meek; largest about 75 mm.—With 6 whitish stripes; the younger specimens still without field-spots, but new whitish spots appear in the older, still immature specimens; chest and belly blue, with white-edged scales. Throat and collar white.

San Juan del Rio. 3 specimens, Dr. Meek; 70–76 mm.

Guanajuato. 6 specimens in the British Museum, collected by Dr. Dugès, three of which only 48 to 50 mm.—These very young forms have 6 very sharp white stripes and very dark spotless fields. Faint pale brown spots in one row appear in the first and second dark brown fields of the 62 mm. specimen. In the two 86–87 mm. specimens the field-spots are white, very sharp and more numerous; and in one of these specimens numerous small white specks have appeared within some of the three pairs of stripes, which themselves have become dull.

Unfortunately most of the specimens from Acambaro to Guanajuato are young, or immature, whilst few, if any, are adult. However, the fact of a gravid female from Patzcuaro seems to indicate that all these lizards belong to a rather small race. The breaking-up of the stripes into whitish spots, characteristic of *C. communis*, is clearly shown at Patzcuaro and at least in one specimen from Guanajuato. It is impossible, with the present material, to say whether the lizards of Acambaro, Celaya, and San Juan del Rio represent the transition from *C. communis* to *C. mexicanus* var. *balsas*, or whether they are potentially *C. com-*

munis and lead on to the Puebla clan, in which the characters of *C. communis* are again intensified.

There is still a gap between San Juan del Rio and Puebla, a distance of 150 miles, whence no *Cnemidophori* have been recorded. I myself have never seen a single specimen in the Valley of Mexico, an absence due no doubt to the high elevation, the limit for this genus being apparently near 7100 feet. Dr. Meek found them in abundance near Puebla, 7100 feet, but the Capital, itself in the depression of the so-called valley, lies some 300 feet higher. San Juan's elevation is 6000 feet, and any way thence to Puebla would imply an ascent of more than 8000 feet, an elevation which may well be prohibitive to any species of *Cnemidophorus*. At Amecameca, which lies at this altitude, I looked for them in vain. It is therefore more likely that the Puebla clan have arrived there by some roundabout way at present unknown. But it is certain that there is no communication between them and those of Yautepec and Cuantla in Morelos, although the distance would be less than 40 miles.

Consequently it seems rather likely that the spotted clan at Puebla, with its isolation from the other *C. communis*, represents a case of convergent evolution. *C. c. balsas* itself is a case of isolation; they are restricted to the basin of the Balsas, bounded on the north by the impassable barrier of high mountains, the southern fringe of the Central plateau, and on the south by the Sierra Madre del Sur, the low pass of which, at Los Cajones, these lizards just manage to cross, but they do not descend beyond, into the Coastal region. What happens to these *Cnemidophori* in Western Michoacan, whether they change or not, into the western form, remains for the present unknown. The same applies to the zoologically undiscovered wide districts of the upper basin of the Balsas.

CNEMIDOPHORUS COMMUNIS COPEI. (Text-figs. 78 A, C, E.)

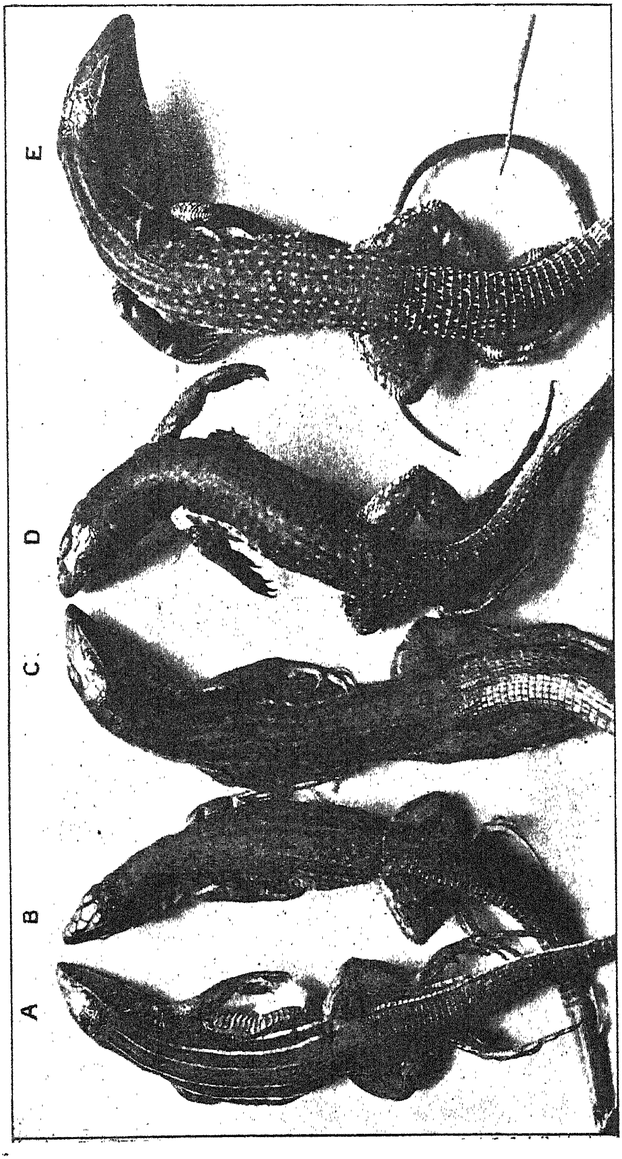
Differing from *C. communis occidentalis* by the increased number of humeral and femoral rows, greater number of pores, and larger size of the body.

Although these are differences of degree only, they are significant because they lead to and are combined with further modifications which change such lizards in Oaxaca and on the Isthmus into a form to which the name of *communis* is no longer applicable.

Of the specimens described in the accompanying table (p. 348), only those from Colima, Manzanillo, San Domingo de Guzman, and apparently those from the island of Cozumel, conform with *C. communis copei*. Possibly those mentioned by Cope from Guatemala may exhibit the same characters, especially the forearm scutes.

Cope's types, about 40 specimens, were sent to Washington by Xantus, who had collected them in the State of Colima, Western Mexico. In the original description, Trans. Am. Phil. Soc. 1877, p. 95, it is stated that *C. communis* has a frenocular, large post-antebrachial scutes, 8 to 9 rows of femoral scales; and from p. 606 of his posthumous work, 1900, the number of pores is to

Text-fig. 78.



Cnemidophorus communis; Field Mus. Nat. Hist.

A = *C. communis copei*, from Manzanillo.
B = *C. communis occidentalis*, from Lake Santa Maria, Chihuahua.
C = *C. communis copei*, from Manzanillo.
D = *C. communis australis*, from Laguna.
E = *C. communis copei*, from Colima.

be inferred as 19–23. In the paper of 1877 he says: "Olive, with 6 light bands with light spots in the intervals, the former

C. communis copei.

Locality and number of specimens examined.	Length. (mm.)	Collar.	Frenocular.	Humeral rows of scales.	Posterior side of forearm.	Femoral rows of scales.	Pores.
Colima .... Field Mus. 1.	122	Large, no granules.	Present.	About 9, gradually getting smaller.	Several rows of scutes.....	8 irregular.	24/25
Manzanillo .... Field Mus. 1.	85	Rather small scales, edge quite granular.	None.	About 7; first 3 or 4 large, rest abruptly smaller.	Several rows of enlarged polygones, enclosing a few scutes.	8.	25/26
Manzanillo .... Field Mus. 1.	109	„ „	Present.	„ „	„ „	8.	24/25
San Domingo de Guzman, Isthmus. Brit. Mus. 1.	♀ 120	Large.	Present.	8 to 9.	3 long rows of enlarged polygones.	8 to 9.	25/24

C. communis australis.

Locality and number of specimens examined.	Length. (mm.)	Frenocular.	Humeral rows of scales.	Posterior side of forearm.	Femoral rows of scales.	Pores.
Lagunas .... Dr. Meek. 7.	78	Present.	7 in all, decreasing gradually.	Several rows of enlarged granules.	7/8.	24/26
„	98	„	8 or 9 in all; 3 or 4 larger.	Several rows of slightly enlarged granules.	9.	23/24
„	99	„	8.	„ „	7.	22/24
„	100	„	7 or 8.	„ „	8.	26/26
„	101	„	4+3 or 4.	„ „	8.	22/23
„	105	„	„	Several rows of enlarged granules.	8 or 9.	22/24
„	130	„	„	Slightly enlarged granules.	7 or 8.	23/23
Cuicatlan, in Oaxaca ...... Dr. Meek. 12.	48	+ +	About 7, gradually getting smaller.	Granular; 2 or 3 long rows just perceptibly larger.	6, 3 of which extend to knee.	19/19
„	56	Fused with 1st ocular.	2 larger, rest small.	„ „	6, „ „	22/23

„	59	+ +	8 or 9 in all.	All granular	6, „ „	19/19
„	61	Right + left fused with ocular.	8, gradually smaller.	Some rows of just perceptibly larger granules.	6 to 7, „ „	21/21
„	62	+ +	3 large and many small behind.	3 rows from elbow to wrist of distinctly enlarged granules.	7, „ „	17/16
„	62	0 0	„ „	Several rows near elbow of enlarged granules.	7 irregular, „	20/19
„	69, with eggs.	+ +	„ „	Several rows of very slightly enlarged granules.	6 left, 7 right, „ „	21
„	72	+ +	8 or 9 in all, 3 large.	Rows of enlarged granules.	7, „ „	20/19
„	71	+ +	8 or 9, gradually getting smaller.	Granules only	7, „ „	21/20
„	90, with eggs.	+ +	„ „	Very slightly enlarged granules near elbow.	8 to 9 irregular.	23/23
„	138	+ +	6 large and several small.	Many rows of very slightly enlarged granules.	8 to 9 irregular.	24/24
„	140	+ +	9 in all.	„ „	9.	22/21
Cozumel „ Brit. Mus. 2.	83	....	....	Two short rows of big polygones, or one big row with two shorter rows of smaller polygones.	6, 3 of which extend to knee.	22
(*C. communis copei*?)	77	....	....		6.	21

C. communis bocourti.

"California" Types. 2.	....	Present.	4 large and 2 small rows.	1 with large scutes; 1 with large polygones.	6.	16/15
"Mexico" Type. 1.	....	Left present.	3+3	Enlarged polygonal granules surrounding one central scute.	5.	15/16
Oaxaca	99	Right present; left absent.	3+3	Cluster of enlarged polygones.	6.	16/17
„	98	Right present; left partly fused with loreal.	3+3	Enlarged polygonal granules surrounding large polygones.	6.	
„	88	Present.	3+3	Much enlarged polygones.	6.	

breaking up into spots in the adult male." Further, there are two varieties of this lizard:—"I. With rows of light spots in the female; in the male the stripes break up into round spots; known from Colima and from Coban in Guatemala." [These I distinguish as *C. communis copei*.—H. G.] "II. No spots, and the bands are unbroken, resembling the young of var. I." Such are said to be known from Guadalajara, Cordova, Guatemala, San Antonio. Which of the various places called Cordova and San Antonio are meant, is left to our imagination. There is a San Antonio in Western Yucatan; but Cope became very vague about his *C. communis*, as shown by the fact that in Proc. Am. Phil. Soc. 1885, p. 379, he returned this kind as from Matamoros, and from S. Antonio in Texas! Concerning this second variety, its definition is too vague; the indifferent characters apply to the young of almost any *C. gularis* in the widest sense; but Cope at that time thought that the possession of a frenocular plate was a distinctive character of his *C. communis*. He partly amended this in his paper in Proc. Am. Phil. Soc. xxiii. 1886, p. 283, where he managed to describe the various evolutionary stages and individual variations of the true *C. gularis* as 4 subspecies, and those of his future *C. scalaris* as 2 subspecies. This, again, he has partly amended in his posthumous work. The synonymy has consequently become rather intricate.

In Trans. Am. Phil. Soc. xvii. 1893. p. 47, it is stated that *C. communis*, from Colima, "reaches a larger size than any others of the *C. gularis*, and its peculiar coloration of small (or sometimes large) yellow spots on a dark olive ground gives it a very distinct appearance."

Lastly, in Cope's key of his subspecies of *C. gularis*, p. 601 in his posthumous work, *C. g. communis*, from "South-western Mexico," is diagnosed as follows:—"Stripes broken up into rows of spots; interspaces with yellow spots; hind legs with or without yellow spots; no posterior femoral stripe; a frenorbital; 5 or 6 infralabials; large."

I have examined the following few specimens, which I refer to as *C. communis copei*, since they seem to conform most completely with Cope's types.

One specimen from Colima (text-fig. 78 E).—Throat white; scales of the large collar with bluish bases. Part of under parts blue, with white edges to the scales. Tail blue all round. Ground-colour above blue-grey, without any black bars or black spots. There are remnants of six faint stripes, each broken up into a row of white spots, and there is one row of whitish spots in each field. Total number of rows of spots about 12. Thighs above and behind, and root of tail, with smaller spots.

One specimen from San Domingo, Isthmus.—With many small, rather irregular yellow spots on the root of the tail, thighs, rump, and lower back. Further forwards these pale spots disappear and faint dark spots appear in the dark brown fields, together with traces of the vanishing stripes 1 and 2. The region of the original mid-field is pale greenish, without any spots.—This specimen has obviously entered the monochrome stage on the anterior half of the body; a feature not uncommon in exceptionally large specimens of various kinds of *Cnemidophorus*.

Two specimens from Manzanillo, the harbour of Colima.—Both are remarkable for the smaller scales which compose the principal row of the collar, the edge of which is formed by several complete rows of small granules. One specimen has 4/4 supraoculars, followed by several rows of small granules behind; in the other the 4th left supraocular is tiny, whilst on the right side the 4th or posterior is split into two. This is interesting because it represents a condition leading to the 3/3 supraoculars which are normal in *C. immutabilis* and *deppei*, in either of which, however, about 10 per cent. show a fourth supraocular as abnormal.

In the larger Manzanillo specimen (text fig. 78 C) the sides of the whitish collar are lead-coloured; on the back are 7 bluish-white stripes, each broken up into a row of paler spots connected by duller portions. Besides a series of larger irregular spots below stripe 1, there are no whitish spots in any of the fields except a few spots in field I. The ground-colour of the back and of the thighs and upper surface is uniform dark blue-grey.

The smaller specimen (text-fig. 78 A) has 6 clear bluish-white stripes running from head to rump, and a short central stripe from head to mid-back partly dissolved into whitish mottlings. The fields are all uniform blackish without any trace of spots.

These two Manzanillo specimens are consequently very much like *C. immutabilis*, from which they differ only by the possession of polygones or scutes on the posterior side of the forearm.

One might be inclined to assume that in this coastal district of Colima the transition from *C. immutabilis* into *C. communis copei* takes place; just as much as in certain parts of Oaxaca there are large *Cnemidophori* which might be interpreted either as the most aberrant clans of *C. communis* trending towards *C. bocourti* and *C. mexicanus*, or as aberrant *C. immutabilis* and *guttatus*, which assume characters typical of *C. communis*. Such are the *C. communis* var. *australis*.

But to return to these Manzanillo specimens. Although the whole stretch of lowland from Manzanillo to Acapulco, a distance of 350 miles, is zoologically unknown, the fact remains for the present that the nearest *bona fide* specimens of *C. immutabilis* were found more than that distance away from Manzanillo, namely by myself still further east of Acapulco. I do not doubt that they extend much further west along the coast, but I also know that the lower Balsas flows through a broad belt of dense forest of a size and type sufficient to exclude these lizards.

Cope's statement that his *C. communis* occurs also at Coban in Guatemala is as worthless as that of Bocourt that he had *C. mexicanus* from Salama in Guatemala. It is quite possible, but until these specimens are critically examined comment is useless. We know that quite a number of Reptiles and Amphibians which are typically at home in Mexico extend far into Central America, occasionally cropping up very locally—a sporadic distribution most likely due to our want of data.

Two specimens (Brit. Mus.) from the Island of Cozumel, east coast of Yucatan, have to be referred to *C. communis copei* until more *Cnemidophori* * from the huge peninsula of Yucatan have been collected.

There are 4 supraoculars. The collar-scales form complete rows, but are distinctly small, as in the Cuicatlan specimens, with which those of Cozumel agree also in the number of femoral rows and pores. The large polygones on the forearm agree with those of San Domingo and Colima. There are 7 pale stripes on the back, all narrow and still complete, but each stripe contains small white specks, and similar small specks are numerous in the fields, on the rump and on the thighs.

It is noteworthy that several of the upper labials are denticulated, exactly as in the *C. deppei* specimens from the same island!

CNEMIDOPHORUS COMMUNIS AUSTRALIS. (Text-figs. 62 C, D; 64 C, D; 65 F; 79 B, C.)

Diagnosis: like *C. copei*, but with entirely granular forearm.

Seven specimens collected by Dr. Meek at Lagunas, a station a little further east than San Domingo, still on the western slope of the Isthmus.—They agree with the typical *C. c. copei* in the large number of femoral pores, of femoral and humeral rows, composition of the large-scaled collar, the large average size of the adults, and by the colour-pattern; but they differ without exception by the complete absence of any scutes or enlarged polygones on the posterior side of the forearm. It is to be remembered that this character is not very reliable in Southern Mexico; see certain specimens of *C. mexicanus* from Cuautla, Sojutla, and Oaxaca, and of *C. communis occidentalis* from Puebla. In some of the 7 specimens the 4th supraocular is very small.

The evolution of the colour-pattern seems to proceed as follows:—

In the youngest specimens the first and second pairs of stripes are still white and complete, quite conspicuous; the third stripe is becoming faint and breaks up into white spots on the lower back and rump. Fields I. and II. are still black, without any spots. Thighs above still without specks; behind reddish, with spots or traces of a pale stripe.

In specimen 98 mm., stripes 3 and 2 are fading or becoming grey from the neck backwards, neck and shoulders becoming grey. Small whitish spots appear in one or two rows in fields I. and II.

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* *C. angusticeps* Cope, Proc. Am. Phil. Soc. xvii. 1877, p. 95. The four specimens seem to be the only *Cnemidophori* known from "Yucatan."

According to Cope they are like his *C. communis*, but distinguished by the very narrow parietal and interparietal plates. Four supraoculars. Edge of collar composed of large scales. Frenocular present.

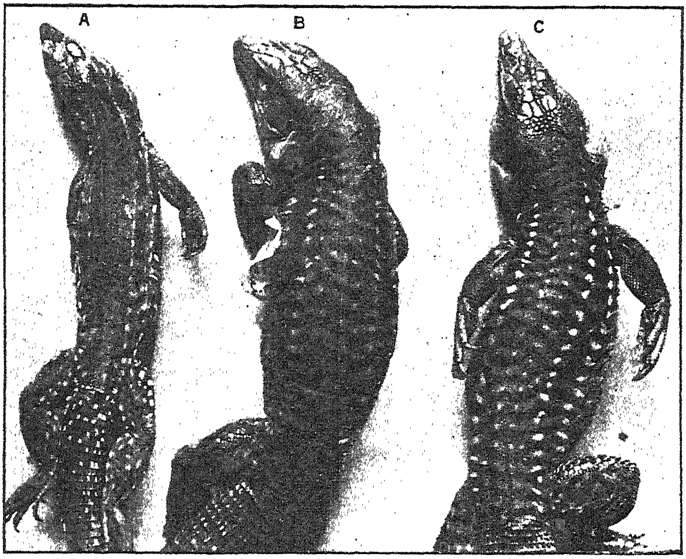
Ground-colour black, and fields much wider and not broken up. The stripes send off lateral processes which give the dark ground-colour a very broken character. Fields green. Adult male of the size of *C. communis* and *C. guttatus*.

on the lower back and rump, others in stripe 3, in the mid-field and upon the thighs. Ground-colour brown, with dark bars in fields I. and II.

Specimen 99 mm. About 12 rows of small whitish spots on the lower back and rump &c. Neck and anterior half of trunk dusky, marbled with dark cross-bars.

Specimens of 100–105 mm. Back dusky, on neck and shoulders with large dark spots or with dark cross-bars. All the stripes are dissolved into small white or yellow spots on the lower back, rump, and root of the tail; ground-colour warm reddish-brown.

Text-fig. 79.



Cnemidophorus communis occidentalis and *C. c. australis.*

A=*C. communis occidentalis*, from Tuxpan; Field Mus. Nat. Hist.
B=*C. communis australis*, 138 & 140 mm., from Cuicatlan; Field Mus. Nat. Hist.

Specimen 130 mm. Whole neck, shoulders, and mid-back uniformly dusky greenish; sides of back rich brown with many small whitish specks, which extend also over the lower back and rump. Legs and thighs above bluish, with many small spots. The throat is pale, partly with a pink tinge, especially in the largest specimen; collar white, mottled with blue. Chest and abdomen soon become mottled or chequered, each scale becoming dark blue or black, but retaining a whitish edge. The terminal half of the tail is red in all specimens.

Twelve specimens collected by Dr. Meek near Cuicatlan. (Text-figs. 64 C; 65 E; 69 B, C.)—This is a station of the Mexican

Southern Railway, about 70 miles N.W. of the town of Oaxaca, and situated almost at the bottom of the deep depression in which collect the head-waters of the River Papaloapan, which mighty river empties itself into the lagoons near Alvarado, south of Vera Cruz. The bottom of the depression is only 600 metres, about 1900 feet, above sea-level, and a rather steep ascent leads to the plateau of the Valley of Oaxaca, 1600 m. = 5250 feet, with an intervening ridge of still greater height. Towards the north-west the ascent out of the gorge is more gradual, but it reaches, before Puebla, an altitude of nearly 8000 feet. To the west is a succession of high mountains. The climate in this long depression is very hot, thoroughly tropical, but of the dry type, as shown by the prevalence of Organ-cactus, small Mimosas, and scrubby Acacias, with scanty low vegetation on the red, gravelly rubble which forms the subsoil.

We are still in complete zoological ignorance about the country for at least 120 miles all around Cuicatlan, except the neighbourhood of the town of Oaxaca. There occur only *C. mexicanus* and *C. bocourti*; to the east of the depression are dense mountain-forests, in which lower down lives only *C. guttatus* with *Ameiva*; at Puebla lives *C. communis occidentalis*, which in its striking pattern, but not structurally, bears a great resemblance to the Cuicatlan specimens.

Supraoculars always 4, followed behind by many small granules, especially when (3 specimens) the posterior supraocular is extremely small, almost reduced to the vanishing point.

Frenocular present in 11 specimens; two specimens have a frenocular on the right side only; in the 12th, a young specimen, the frenocular of both sides is fused with the first preocular.

Collar (text-figs. 64 C, 65 F) composed of mostly medium-sized to rather small scales, sometimes passing quite gradually into the gulars. In nearly all specimens at least some granules are visible between the scales of the posterior border, and sometimes these granules form a complete row. But in the largest specimen, and in one of 72 mm., the scales forming the edge are distinctly large.

Humerus covered in front with many rows of scales, about 8 to 10 in all; sometimes they decrease in size from before backwards, and as a rule the hindmost rows are continuous with the slightly enlarged granules of the forearm; but in most cases some of the front rows, either 2, mostly 3, rarely 5 or 6, are distinctly larger than the rest.

Forearm covered in front with 2½, mostly 3, complete rows of scutes.

Forearm, posterior surface, never covered with scutes or scales. In 5 specimens the granules are almost imperceptibly larger than the rest; in 5 other specimens are several rows of slightly enlarged granules, either near the elbow or near the wrist; only in 2 specimens enlarged polygonal granules form three long rows.

Femur.—The rows of scales show a continuous variation from 6 to 9. 6 occurred 3 times; 6 to 7 irregular twice; 6 right, 7 left once; 7 regular 3 times; 8 to 9 irregular twice; 9 regular rows once. The average is consequently rather high.

Tibia with 2½, mostly 3, rows of scutes.

Femoral pores: ranging from 17/16 to 24/24 each once, 19 twice, 20/19 twice, 21/20 twice, 21/22 once, and 23 twice. Average distinctly high, about 21.

Size.—The 12 specimens range from 48 mm. to 138 and 140 mm., the two largest being exceptionally fine males. A female of 90 mm. and another of 69 mm. with eggs.

Coloration of under parts.—The throat is yellowish, or clearly pink. The collar of the female is whitish, sometimes with a blue tinge on the sides; in the medium-sized males quite black, but pink like the chest in the two largest specimens. The chest and abdomen change from whitish or leaden hues through mottled blue to uniform blue-black in the males. This dark pigmentation extends upon the arms and thighs, and partly upon the preanal region. The under surface of the tail, at least its distal half, is yellow to red.

Pattern and coloration of upper surface.—These lizards start with 3 pairs of stripes, of which only the 1st and 2nd are whitish, whilst the 3rd is dull. Frequently there is a grey central stripe, bordered with black. The fields are black, at first spotless. Faint pale spots appear later. When the specimens have passed about 70 mm. in length a few small, but sharply marked, white-blue spots appear in the fields I. and II., and stripe 1 is quite broken up into large black and white patches Then stripe 2 is transformed into a series of round blue-white spots, whilst stripe 3 fades away, leaving a very broad mid-field region 2–2, which is green with blackish tiger-bars. Or, all the stripes are broken up into rows of large white-blue spots, and large tiger-bars run right across the back from flank to flank, producing a strikingly handsome pattern upon the otherwise almost uniform dark olive ground (text-fig. 79 B, C).

The continuation of stripe 1 on the hinder side of the thigh breaks up early into pale spots, which disappear in the largest specimens.

The change of pattern from youth to age of these Cuicatlan Lizards is absolutely different from that of *C. mexicanus*, and still more from that of *C. immutabilis* and *guttatus*, while it agrees with that of *C. communis*. *C. bocourti*, although geographically the nearest so far as at present known, is structurally too different. The same applies to the *C. communis occidentalis* with its outlying clan of Puebla. These Cuicatlan specimens differ much more from those of Puebla than from those of Lagunas; in fact, the only difference is the frequent occurrence of a smaller-scaled collar with a granular edge in the Cuicatlan specimens: but since in some of them the collar-scales are as large as in those of Lagunas, the importance of this character vanishes. The same applies to the number of femoral rows and the pores, which varies considerably.

Thus it has come to pass that some of these Cuicatlan specimens (those with very small 4th supraocular, small collar-scales, and granular edge, entirely granular forearm, and with only 6 femoral rows) have become so different from the typical *C. communis* of Colima, that nobody could or would refer them to *C. communis*, nor to any of the *gularis*-group at all, if the specimens of Lagunas and San Domingo were not known. The most reliable guide happens after all, in this case, to be the colour-pattern.

It may well be asked why the Cuicatlan specimens should not be grouped in the *immutabilis* lot: but, first, the collar, when large, is of the unmistakable *gularis* type; secondly, when the number of pores is decidedly high this feature is never associated, either in *immutabilis* or in *guttatus*, with three regular rows of femoral scales extending down to the knee; thirdly, the evolution of the pattern. Although in *immutabilis* and in *guttatus* the stripes break up into rows of spots, transverse bars are quite unknown, while again in *C. mexicanus*, of Oaxaca, in spite of its tiger-bars, this mode of breaking up the stripes and the appearance of new white spots in their place are equally unknown.

Consequently it is not due to chance that the Laguna-Cuicatlan specimens are considered as of the *C. communis* stock, modified in the direction of the typical Tierra caliente species *C. immutabilis* and *guttatus*. In short the var. *australis*, although in many respects intermediate, is not a true link between the *gularis-communis* and the *immutabilis-deppei* groups, but is the terminal outlier of the former.

CNEMIDOPHORUS COMMUNIS BOCOURTI Blgr. (Text-fig. 80.)

Diagnosis.—4 supraoculars. Collar composed of large scales, which form the edge. Humerals 6; femorals 5 to 6. Posterior side of forearm with some large polygones or scutes. Pores 15–18. About 12 rows of small yellow spots on red-brown ground-colour. Length about 100 mm. Oaxaca.

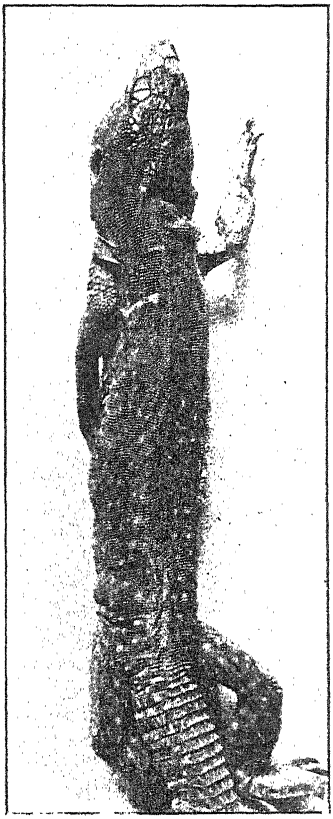
Unfortunately the three type-specimens in the British Museum are without satisfactory localities. One is from "Mexico," the others were got by "Cumming, California," a locality which may safely be dismissed as erroneous. In 1902 I caught three specimens in the outskirts of the town of Oaxaca, indistinguishable from the types of this well-marked lizard.

Boulenger gives the number of femoral rows as 8 or 9, but according to the plan adopted throughout this paper, *i. e.* counting from the row nearest the pores to the largest row on the anterior side of the thigh and not beyond, there are only 6 or 5 rows.

Throat and collar are pale with a greenish tinge; rest of under parts, including thighs, blue-black, mottled with bluish-white scales. General colour above warm reddish brown, turning into olive towards the shoulders and the neck; with numerous yellow, small, and sharply defined spots, which are arranged in about 12–14 longitudinal rows. These spots are most numerous on the rump, extending also upon the root of the tail and over the whole thigh; towards the shoulders they become scarcer, and further forwards they disappear, while faint traces of the original pale stripes 1 and 2 remain visible.

In very old specimens the spots are small and irregular, restricted to the lower back, rump, and thighs, the rest of the back being spotless brown with a warm reddish tint.

Text-fig. 80.



Cnemidophorus bocourti from Oaxaca.

There is no doubt that the original stripes become dull and merge into the ground-colour, whilst new spots of pale tissue develop in these stripes, and a row of equally numerous spots is developed in each field and below stripe 1. The spots remain small and do not become confluent. The evolution of the pattern is the same as that of *C. communis* in general, but it also recalls *C. guttatus*. Structurally, however, *C. bocourti* forms the very opposite to *C. guttatus* and to those specimens of *C. communis copei* and *C. c. australis* from Colima, the Isthmus*, and Cuicatlan, which are very similarly coloured.

In fact *C. bocourti* is structurally indistinguishable from many specimens of *C. communis occidentalis*, and from some of the *C. mexicanus* of the Balsas basin. Fundamentally, the evolution of its pattern is that of the former, but when most agreeing in coloration with the *copei* or *australis* varieties it differs most from these structurally; or, *vice versâ*, when structurally most like *mexicanus* it is diametrically opposed to it in coloration. Upon this ambiguity rests the best claim for separate recognition of *C. bocourti*, which after all happens to be one of the most easily recognised forms of the whole *C. gularis* group.

CNEMIDOPHORUS MEXICANUS Peters.

(Text-figs. 69; 81 A, B, C, D, F; 82 A–D, &c.)

Diagnosis.—Large-sized *C. gularis* in which the original stripes do not develop pale spots, but are broken up by the encroaching black of the fields and by the transversely combining brownish field-spots, resulting eventually in a tiger-barred pattern.

The most extreme development is reached in Oaxaca; this variety I distinguish as var. *typica*. They reach the largest size, the tiger-pattern is most pronounced, but the collar and the covering of the posterior side of the forearm are variable, inclining more towards granules.

Those of the Balsas River-basin are distinguished by a strong collar, prevalence of scutes on the forearm, and far less pronounced, more incipient tiger-pattern. They seem, moreover, as fits their distribution, to pass into aberrant *C. communis occidentalis*. These I refer to as *C. mexicanus* var. *balsas*.

It is significant that these Oaxaca specimens exhibit the same trend of variation away from their relations (decreasing collar and more granular arm-scales and tendency to tiger-pattern) as do the representatives of *C. communis copei* in the State of Oaxaca in the shape of *C. c. australis*.

It is irony of fate that the three type-specimens of *C. mexicanus* are all immature, and show but little of the typical features.

Range.—The temperate regions of the States of Oaxaca and Guerrero, descending into the tropics of South Oaxaca and into the tropical portion of the Balsas basin.

Supraoculars 4, apparently without exception; the posterior separated from the parietal plates by one row of three or four elongated granules.

Frenocular variable.

Collar variable. It reaches its largest development in the var. *balsas*, being composed of very large scales, one row of which forms the edge without any intermediate granules, *e. g.* text-fig. 65 B. More frequently the scales of the last row are only of moderate size (text-fig. 64 B), bordered behind by scattered granules, or even by one or more complete rows of granules. On the average, the collar-type of the var. *typica* is that of *C. sexlineatus* and of the *deppei*-group, differing rather much from the

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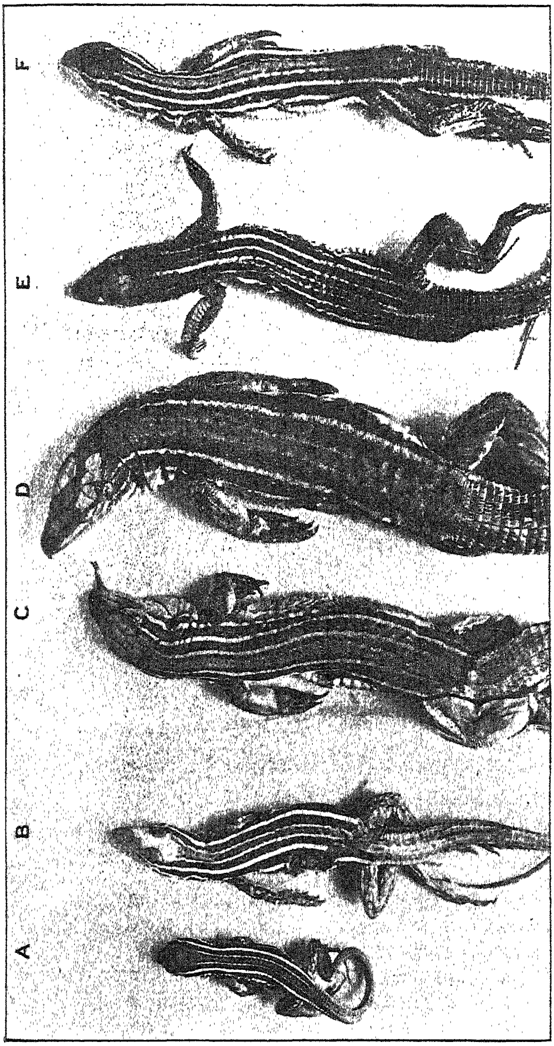
* In my paper Proc. R. S. 1903, p. 118, I had referred to *C. bocourti* the large specimen from San Domingo, now mentioned as *C. communis copei*, p. 350; and the Nayarete specimens now described on p. 342.

Text-fig. 81.



Cnemidophorus mexicanus typicus.

A = Very young specimen from Oaxaca. With 6 stripes and mottled mid-field; stripe 2 is the most conspicuous.
B = Young, Totolapan No. 1.
C = Immature, Oaxaca No. 1, with faint spots in fields I. and II.
D = ,, Totolapan No. 2; the dull field-spots are enlarged and confluent.
The subsequent stages are represented by text-fig. 82.
E = Immature *C. immutabilis* from Rincon, near Los Cajones. With 7 to 8 stripes. Three supraoculars. Posterior forearm all granular.
F = Immature *C. mexicanus* var. *balsas* from Los Cajones. With field-spots. Four supraoculars. Enlarged polygones, and scutes on posterior forearm.

large-scaled collar of the var. *balsas* and of *C. communis occidentalis.*

Humerus mostly with 4 large and about as many smaller rows of scales, some of which pass gradually on the elbow into those of the *posterior side of the forearm.*

Forearm (text-fig. 63 A–D; 61 C).—Here prevails considerable variation. It is rarely covered entirely with granules, several rows being enlarged, although sometimes but slightly; as a rule more obviously so that a cluster, or several rows of large polygones, are present; only in one specimen, the smallest of the types, is the one long row of large, transverse scutes in the var. *typica.* But in the var. *balsas* large scutes are much more common. The great variability, even in specimens from the same locality, is shown in the table, p. 362.

Front of forearm (text-fig. 61 A, B, D).—Mostly with three complete rows of plates, rarely with only two large rows, sometimes with a smaller fourth lateral row. Attention may be drawn to the peculiar arrangement (text-fig. 61 I) which was observed in a specimen from Cuernavaca and one from the southern slope of the Cajones ridge, a very good illustration of the fact that in the kaleidoscopic changes of this scutellation exactly the same arrangement may be hit upon "accidentally" in widely separated specimens.

Front of tibia with 3 to 4 rows.

Femur mostly with 7 rows, 3 of which extend to the knee, as is the case in *C. sexlineatus* and *C. deppei.*

Femoral pores mostly from 16–20; cases of 23 or 24 being quite exceptional.

The males reach a great size; specimens of 120 mm. being quite common. The largest, of 132 mm., from Totolapan, is one of the record specimens of *Cnemidophori*, surpassed only by two specimens of *C. communis australis* from Cuicatlan, likewise in the State of Oaxaca.

CNEMIDOPHORUS MEXICANUS, var. TYPICA.

Material examined:—

I. The three type-specimens in the Berlin Museum, collected by Uhde, and supposed to be from the neighbourhood of the town of Oaxaca.

II. 16 specimens collected by myself a few miles to the west of Oaxaca town on open, rather barren terrain, or on the slopes of stony ravines with scanty scrub.

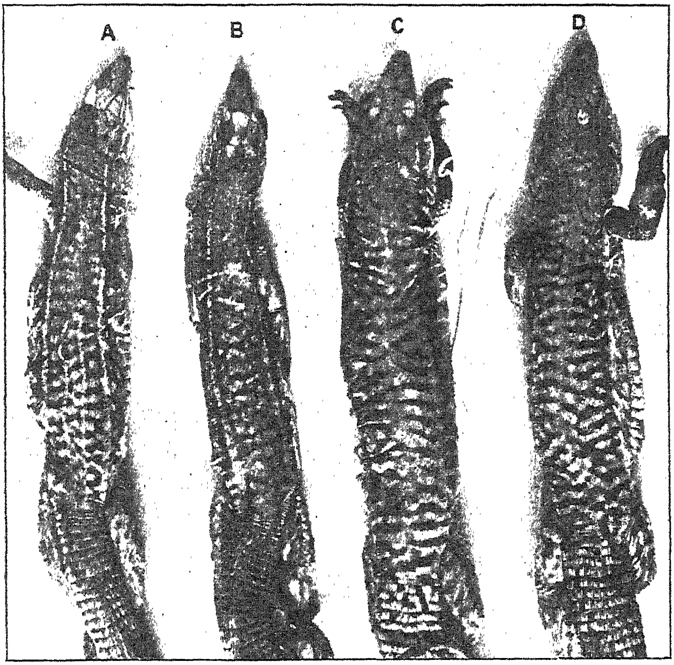
III. 4 specimens at Totolapan, a similar terrain, near the southern foot of the Mexican plateau, in the Tierra caliente.

Unfortunately all the type-specimens are young. They happen to agree with each other, and differ from those collected by myself by decidedly larger scutes on the posterior side of the forearm.

Coloration.—*Under parts* mostly uniform pale yellowish white, with a reddish tinge on the hind limbs and on the throat, while the under surface of the tail and the whole of its terminal half all round are of an orange to almost brick-red colour. The collar is never dark. The chest and abdomen of old specimens, especially males, are suffused with greenish or faint blue, while the basal parts of the scales are blackish. After removal of the horny portion of the epidermis, which is quite opaque, the scales appear entirely blue-black.—The 61 mm. type-specimen is quite exceptional; chest and belly being much mottled with black, this pigment being almost preponderant on the chest.

Upper parts: During their growth these lizards pass through an extraordinary series of changes in their colours and pattern (text-figs. 69, 81, 82).

Text-fig. 82.



Cnemidophorus mexicanus typicus.

A = Oaxaca No. 9. Third pair of stripes partly vanishing and cut across by the increasing pale field-patches.
B = Oaxaca No. 8. Third pair of stripes restricted to faint narrow traces on the neck.
C = Totolapan No. 3. Old specimen; completely tiger-barred.
D = Oaxaca No. 16. " " "

Stage A.—The young, up to about 50-60 mm., possesses three pairs of complete white stripes, sharply alternating with dark

C. mexicanus, var. *typica*.

Locality and number of specimens examined.	Length. (mm.)	Frenocular.	Humeral rows of scales.	Posterior side of forearm.	Femoral rows of scales.	Pores.
Oaxaca. 16	37	Present.	4+several smaller.	Very slightly enlarged granules.	7 to 8; 3 of the largest extend to the knee in all specimens.	20/20
„	87	Absent.	„ „	Several rows of enlarged polygonal granules.	6 to 7	17/16
„	83	„	„ „	Short cluster of enlarged polygones	6	17/17
„	130	Present.	„ „	Rows of enlarged polygonal granules.	8	23/22
„	117	„	„ „	Only very slightly enlarged granules.	7	18/18
„	120	„	„ „	Several rows of enlarged polygonal granules.	7	18/19
Totolapan. 4	60	„	„ „	Rows of enlarged granules.	6 to 7; 3 of the largest extend to the knee in all specimens.	20/20
„	100	Absent.	„ „	Short cluster of slightly enlarged granules.	7	16/16
„	132	„	„ „	Slightly enlarged granules.	7	19/20
Types of *C. mexicanus* Peters. "Oaxaca." 3.	50	....	4+4	One long row of large transverse scutes.	6; 3 of which extend to the knee.	17/19
„ „	61	....	3+5	One short row of very large scutes, surrounded by smaller polygones.	5 only, of which 2 reach the knee.	16/16
„ „	80	....	4+3	Long cluster of large polygones in three rows.	7; 3 irregularly to knee.	15/16

brown fields. The mid-field between the narrow stripes 3–3 is pale, bordered by rows of dark specks.

Stage B.—Faint, pale brown spots appear in the first and second fields, and the mid-field becomes lighter in this way that the dark pigment is arranged in more continuous lines against the inner borders of the third stripes; and occasionally there appears a darker central streak in the broadening mid-field. Then, with a length of about 70 mm., the field-spots, which are never sharp, become lighter and more numerous, and arrange themselves in one or two rows in each field, and the pale portions of the widening mid-field become greenish.

Stage C.—When the lizards approach maturity, length about 100 mm., the stripes 1 and 2, hitherto very conspicuous, become dull and lose their sharp contours. The pale field-spots become transversely confluent where they existed in double rows in a field, or they become enlarged transversely, so that each field is broken up into some 20 or more dark cross-bars, alternating with pale bars. Both kinds of bars encroach upon the dissolving stripes 1, 2, and 3, whilst the remaining portions of these lines join, or merge into, the pale brown or olive-grey, which gradually becomes the predominant ground-colour.

Stage D.—Ultimately the whole back and the sides of the body assume a very complex pattern: brown, pale brown, olive, and whitish colours, mottled or vemiculated; on the whole, however, decidedly cross-barred. The black bars are of course most conspicuous, and in some cases the black bars of the right and left sides meet across the back, producing a strikingly handsome tiger-pattern. The extent to which the longitudinal stripes disappear varies much, and in the adult of both sexes the detail of the whole complicated pattern is scarcely the same in two individuals from the same locality.

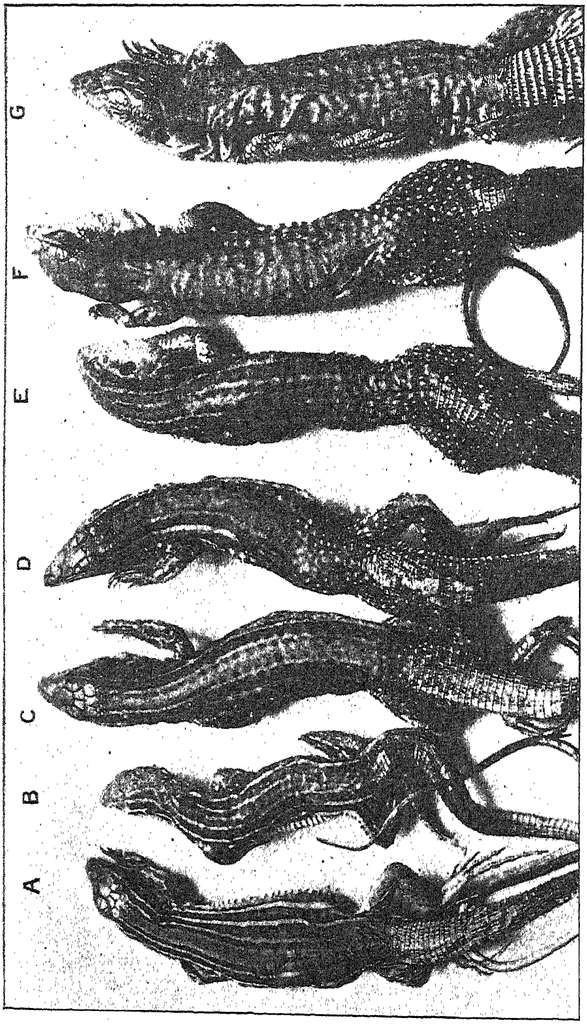
A noteworthy character of these lizards is the complete absence of any pale spots except those transitory faint spots in the fields of young specimens. In this respect they differ conspicuously from *C. communis* and its relations, with their numerous sharply marked white, yellow, or blue spots either all over the upper surface, or at least on the rump, root of the tail, and on the thighs. The thighs of specimens from Oaxaca and Totolapan are always marbled, and the usual white stripe on the posterior side of the thigh is broken up and disappears at an early stage.

CNEMIDOPHORUS MEXICANUS, var. BALSAS. (Text-fig. 83.)

Number of specimens examined about 71.

Within the Basin of the Balsas River, from Cuernavaca in the north to Chilpancingo in the south, the genus *Cnemidophorus* is, besides *C. deppei*, represented by a form which differs from the typical *C. communis occidentalis* mainly in the evolution of the dorsal pattern. It might be described as an intensified, enlarged *C. gularis* of which the stripes become destroyed by invasion from the fields, whilst they are not broken up into series of light spots, nor are such new spots developed in the stripes. Pale brown field-spots are invariably present in youth and middle age. The collar is the strongest and most complete in the whole genus, without granules, except here and there a granule inserted between neighbouring scales of the edge.

Text fig. 83.



Cnemidophorus mexicanus, var. *balsas*.

A = Balsas No. 6, with 6 stripes and broad pale centre.
B = Ixtla-Iguala No. 4, with 7 stripes.
C = Cuernavaca No. 3.
D = Cuernavaca No. 1, with many small white spots on rump, tail, and thighs.
E = Ixtla-Iguala No. 6.
F & G = Ixtla-Iguala Nos. 11 and 12, with moderate tiger-pattern; all traces of stripes lost.

The evolution of the dorsal pattern is somewhat complicated in detail, owing to the considerable amount of individual variation and to the fact that many specimens stop short at a stage, while others, in other localities, pass through and beyond, when they have reached the corresponding size or age.

The young start with 6 pale, sharply marked whitish stripes upon very dark, almost black ground, but the mid-field is grey, with inner dark borders, and this mid-field is frequently subdivided into one or two greenish stripes, so that the total number of stripes is 7 or 8. The fields are originally uniform dark, blackish; then turn up pale field-spots, mostly light brown or reddish brown, in one or two rows. These spots become transversely confluent within each field, first in the lateral field and in field I., then in field II.; and thus the fields are cut up into irregular alternating black and brown bars. These short cross-bars, restricted to within their fields, often remain imperfect; so that the total effect is one of black and pale spots or patches. Meanwhile the stripes change from whitish to pale grey-green. The originally brownish spots and bars are likewise liable to change colour. Either they become dull white, especially on the lateral field, or they become grey-green, especially in fields II. and III.; those in field I. retain their brown colour longest.

As a rule the stripes remain intact unless they are joined by the spreading grey-green bars. This fusion of the stripes with the spreading greenish patches and bars imitates the tendency of turning the grey-green into the prevailing ground-colour; whilst the black portions, originally the dominant colour, are henceforth allowed to grow into narrow cross-bars, which can spread over several fields by crossing the self-effacing stripes. The ultimate result is a moderate black tiger-barring upon an ever-increasing green-grey ground, which itself tends to become duller and darker. This condition is in *C. mexicanus* var. *balsas* reached but rarely, for instance by a few specimens from Chilpancingo, Rio Balsas, and Iguala.

Another complication initiates what becomes the characteristic feature in *C. communis*. The thighs, the root of the tail, and the rump develop numerous small but conspicuous whitish spots or specks, which are partly the modified original field-spots, and, most important, white or yellowish spots which appear in the original pale stripes, hand in hand with a blackening of the ground-colour. This tendency to spottiness gradually extends from the rump upon the lower back and especially along the first stripe. These white or yellowish spots on thighs, root of tail, rump, and lower back show no tendency to fuse with each other; on the contrary, they seem to become more pronounced and more numerous with age. Such specimens, all adult, are some of those from Cuernavaca, Iguala, and Chilpancingo (text-fig. 83 D, E, F).

Colour of under surface.—The throat and collar are always whitish, never blue or black or mottled, but the throat is often strongly suffused with pink, especially in the adult males. Chest and abdomen are at first whitish, but they soon become suffused with blue, and the scales of the flanks and belly become with age

C. mexicanus, var. *balsas*.

Locality and number of specimens examined.	Length. (mm.)	Frenocular.	Humeral rows of scales.	Posterior side of forearm.	Femoral rows of scales.	Pores.
Cuernavaca .... H. G. 18.	Smallest ♀ with eggs 66; largest 93. Largest ♂ 100.	Mostly present.	5 to 7 in all, with great variations; from 5 all large to 3, 4, 5 large and followed by smaller scales.	Small nest of polygones ...... 1 Short rows of scutes, restricted to middle of arm .... 2 Large scutes, mostly in several rows, the middle the biggest 14	Mostly 6 rows. 1 with only 5 rows. 3 „ 5 to 6 „ 2 „ 7 „	1 with 15/15. 2 „ 20/21. Mostly 18-20.
Cuautla .... Meek. 11.	Largest ♀ 77; „ ♂ 90, 103.	8 with 1 each side. 1 „ 2 „ 1 fused w. frenal. 1 without.	Mostly 3 large and 3 smaller; rarely only 5 in all, or increased to 7.	Granules only .... 1 Polygones .... 4 Scutes .... 2 Very broad scutes............ 4	Mostly 6 and 7; once 7 to 8 rows. 3 rows reaching the knee.	1 with 20/20. Mostly 16 and 17.
Yautepec .... Meek. 3.	50, 54, 75.	Present.	5 and 6, the first 3 larger.	Nest of larger scutes nearer the elbow.	5 to 6; 6; 6 to 7 rows.	18 and 19.
Jojutla .... Meek. 6.	Largest 68 and 80.	2 with 1 each side. 1 w. 2 right, 1 left, 1 without.	5 and 6.	Nest of polygones nearer elbow 1 Nest of large scutes .... 2 Large scutes on ¾ of arm...... 1 Large scutes down to wrist... 2	6 and 7.	16/17 to 20/20.
West of Puente de Ixtla, and Iguala. H. G. 16.	Largest 98, 109.	Mostly present. 1 right fused with 2nd preocular, left with 1st preocular.	5 to 7; 7 only once. Usually the first 3 are larger than the rest.	Several rows of slightly enlarged scutes and polygones 2 A nest of a few large scutes on mid-arm.................. 4 One row of very large scutes, bordered by smaller rows ... 10	Average 6 & 7, of which 3 reach the knee. 2 with 5 rows. 1 „ 5 or 6. 7 „ 6. 1 „ 6 or 7. 5 „ 7.	1 with 17/16. „ 21/20. „ 22/22. „ 23/23. Mostly 18-20.
Rio Balsas .... H. G. 7.	Largest ♂ 97, 106; ♀ with eggs 78.	Present or absent, sometimes one-sided.	5 to 7.	Rows of enlarged polygones down to wrist .... 2 Long cluster of large scutes . 2 Long rows of large scutes ... 3	3 with 6 regular rows, of which 3 reach the knee. 1 with 6 to 7, irregular. 2 with 7. Average nearer 7 than 6. 1 with 9 right and 7 left.	17/17; 18/17; 20/19; 20/20; 21/21 twice; 24/23. Average 20.
Chilpancingo.......... H. G. 9.	Largest ♂ 93, 96; ♀ with eggs 82.	Present or absent, sometimes fused with 1st or 2nd preocular.	Once only 2, mostly 3 or 4 larger than the rest.	Nest of moderate scutes ...... 2 Nest of several rows of scutes. 2 Large row of scutes 5	1 with 5 rows. 3 „ 5 to 6. 3 „ 6. 2 „ 7. Average low, less than 6.	15/15 to 19/19 with every intermediate number. Average 17 & 18
Rincon, south foot of Los Cajones. H.G. 1.	♀ 77.	Present.	4 large and 2 small rows.	Large scutes on the proximal half.	6 irregular rows.	17/16.

mottled with blackish. Although much black pigment may become deposited, it is always restricted to the deeper strata, so that the under parts never appear dark. The light stripe behind the tail is invariably broken up. The under surface of the tail is white to yellowish flesh-colour.

Remarks upon the Pattern prevailing in various Localities.

Cuernavaca (text-fig. 83 C, D).—The 6 principal stripes remain intact, except in specimens with many yellow spots on the rump, when stripe 1 is broken into white beads; and in some old males the black cross-bars invade the stripe 3. Even in the oldest specimens the black and brown cross-bars are mostly confined to their respective fields. In one handsome male the upper chest is mottled pink and blue.

Cuautla.—None reaches the stage in which the stripes are anywhere destroyed. The largest male shows no cross-bars, only double spots.

Jojutla.—Striped; nowhere with white spots.

Ixtla and Iguala (text-fig. 83 E, F, G).—In old males the stripes are very dull; black and light cross-bars encroach upon the stripes, producing tiger-bars; with or without numerous small white spots on rump and thighs.

Rio Balsas (text-fig. 83 A).—The stripes vanish into the ashy-brown or olive-grey ground-colour, which becomes studded with numerous small black spots on the back. On the flanks and sides of the trunk short irregular black bars alternate with grey or whitish short bars. There are no whitish spots on rump, thigh, or tail.

These Balsas specimens, in their isolation, are remarkable for their general coloration and pattern, combined with a rather high number of femoral scales and pores.

Chilpancingo.—Pale grey and black tiger-bars combined with vanishing first and second stripes are rather prevalent. Pale small spots are restricted to the hind limbs. The number of femoral pores is rather low.

TESSELLATUS-Group.

Specimens examined :—

C. perplexus.	2, Brit. Mus., 72 and 69 mm.; from Bernalillo Co., New Mexico.
C. tessellatus.	2, Brit. Mus., 56 and 92 mm.; from Arizona, or New Mexico?
	1, Brit. Mus., 82 mm.; from Julian Mountains, Cal. (*C. stejnegeri.*)
	1, Field Mus., 93 mm.; from El Paso. (*C. multiscutatus.*)
C. maximus.	2, Brit. Mus.
C. melanostethus.	2, Brit. Mus.; Fort Lowell, Arizona.
	2, Field Mus.; Lerdo, Durango-Coahuila. (*C. variolosus.*)

Key to the Species &c. of the TESSELLATUS*-Group.*

- Nasal not touching second labial.
  - Throat pale, not spotted.
    - 7 stripes, no field-spots. Length 86 mm. New Mexico. *C. perplexus.*
    - 8 stripes, no field-spots. Length 60 mm. Nuevo Leon. *C. octolineatus.*
    - No stripes, no field-spots. Length 56 mm. Nuevo Leon. *C. inornatus.*
  - Throat pale, with dark spots.
    - Brown marbled. Length 120 mm. Lower California. *C. maximus.*
    - With field-spots and stripes, ultimately spotted and barred with black and white. Length 102 mm. ....South-western U.S.A. *C. tessellatus.* =*stejnegeri.*
    - Becomes unicoloured, with 3 rows of blackish spots. Thighs and tail below vermilion. Length 100 mm. San Margarita Island, West Lower California. *C. rubidus.*
  - Throat and rest of under parts blackish.
    - Vermiculated and spotted on bluish ground. Length 86 mm. North Mexico to Arizona. *C. melanostethus.* =*C. variolosus.*
    - Monochrome blackish. Length 82 mm. Sonora and San Martyr Island, Gulf of California .... *C. martyris.* =*C. æthiops.*
- Nasal in contact with second labial.
  - Only 12 or 13 pores. Length 55 mm. Cedros Island, Lower California. *C. labialis.*

TESSELLATUS-Group.

Definition.—*Cnemidophorus* with 4 supraoculars, a collar composed of many small scales, and the posterior side of the forearm covered with granules only.

This group, centred in Sonoraland, is composed of a great number of definable forms and has a very wide distribution; roughly speaking, from San Francisco across Nevada to the Great Salt Lake, thence south-eastwards through the whole basin of the Rio Grande down to Laredo, from El Paso to Hermosillo in Sonora, and from the southern end of Lower California again to San Francisco. Nearly the whole of this wide range is inhabited by the central form *C. tessellatus* with its correspondingly greatest amount of variation in structure and pattern of coloration. Almost all the other forms are rather local.

CNEMIDOPHORUS PERPLEXUS Baird.

Unfortunately only two specimens of this apparently least specialised kind could be examined. Some have been recorded from the Valley of the Rio Grande near and north of El Paso; others from Pecos in Texas by A. E. Brown, Proc. Acad. Phil. 1903, p. 547.

According to Cope, the colour-characters are the possession and retention of 7 stripes, absence of pale spots in the fields, and absence of dark spots on the throat and on the rest of the under parts. Larger humeral scales in 4 rows, femorals in 6 rows, counting from the largest to the pores which number 19; size from snout to vent 86 mm.

Two specimens in the Brit. Mus. from Bernalillo Co., New Mexico, 67 and 72 mm. in length, possess 7 complete white stripes, the central being zigzag, but there are white spots in the first and second fields. Under parts all creamy white; throat without spots. Structurally they agree with *C. perplexus*. Humerus with 4 rows of large scales, femur with 6 or 7 rows; anterior side of forearm and tibia with 3 rows; pores 18 and 19.

Specimens from Pecos according to Brown:—Largest 64 mm.; 7 stripes; pores 13–18, averaging 15 only. He remarks that a few of the scales (granules) of the posterior side of the forearm are sometimes a little enlarged, and that two of the specimens have "large scales on the edge of the collar" instead of granules. Brown therefore considers *C. perplexus* as a subspecies of *C. sexlineatus*.

CNEMIDOPHORUS TESSELLATUS* Say. (Text-figs. 70 & 64 A.)

Length of adult 80–100 mm. Humerus with 4 or 5 large rows (Brown, 4 to 7); femur mostly with 7, rarely with 6 or 8 rows. Pores, according to Cope, 17–21; according to Brown two specimens from Pecos with 24 and 25; fifteen specimens from Alamogordo, New Mexico, with 22–25, average 23.

There is a variable number of stripes which tend to become destroyed by white field-spots. Throat and rest of under parts with sparse black spots.

Range. From the Coast of California to Nevada up to 6500 ft., Utah, Arizona, New Mexico, Basin of Rio Grande and Pecos in Texas. Also in Lower California and on Cedros Island.

The variations of the colour-pattern are enormous and seem to be progressive, bearing several striking analogies to those observed in the *gularis* and *deppei* groups. The successive changes, mainly as pointed out and figured by Cope, are as follows. It must be borne in mind that the individuals of local clans may stop short at any of these stages, cases of Eimer's "Genepistasis."

The young start with 6 or more stripes; the first and second of which break up into longitudinal spots, and a series of white lateral spots seems likewise frequent. White spots appear in the fields, and either join the white stripes, or they gradually break up the fields transversely. This may result in the formation of white and black cross-bars on the flanks. The stripes prevail on the neck, shoulder, and mid-back, while spots become predominant on the rump. To such specimens applies the name of *C. gracilis* B. & G.*

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* CNEMIDOPHORUS GRAHAMI Baird & Girard.

Based upon two specimens from between El Paso and San Antonio in New Mexico; two other specimens reported from Jule Cañon on the Staked Plain of Texas.

According to Cope, *C. stejnegeri* (which itself is synonymous with *C. tessellatus*) differs from *C. grahami* in coloration only. If this were the case, the latter would also belong to the *tessellatus*-group, most likely to *C. perplexus*, with which the pattern of colour agrees very well. Possibly the *grahami* specimens have somewhat enlarged scales forming a central cluster on the mesoptychium, as is not uncommon in *C. tessellatus*, e. g., from San Diego, and this feature has been exaggerated in fig. 117 of Cope's work. The figures on pl. 37 of the Mexican Boundary Commission are too fanciful to be considered.

A. E. Brown records one specimen from Pecos, Texas, with 21 pores, "almost identical with *C. sexlineatus* in scale characters."

The next question is *whether* the white colour becomes prevalent and represents the ground-colour, with black spots and lines; and this condition leads to an extreme in which the white ground-colour turns to dull or brownish, interspersed with black spots only, which ultimately may be counted in transverse or in longitudinal rows (*C. rubidus*, text-fig. 70 E, see p. 293). *Or*, the black becomes prevalent; and this condition leads to various appearances, namely, dark-coloured white-spotted (leopards), or with a transverse black and white gridiron pattern on the rump, or black and white cross-barred on rump and flanks (tigers).

Such leopards, gridirons, or tigers, as the case may be (e. g. *C. tigris* of Baird & Gir., and also of Cope, Proc. Am. Phil. Soc. 1886, p. 283), occur in the Sonoran zone on the open desert, sometimes together with the Leopard-lizard *Crotaphytus wisliceni*, as pointed out by Merriam, quoted by Cope, p. 578. They are also common in the Mojave desert; in Utah, and in Nevada on Juniper Mountain up to 6500 ft.

These spotted and barred individuals represent one kind of desert form; another kind is *C. rubidus*, in which the whole dorsal surface has become uniform light brown, interspersed with black spots. These spots again may become evanescent from neck and shoulders backwards; such specimens are recorded from S. Margarita Island, Lower California.

It would be interesting to ascertain to what extent the more striped individuals coincide in their habitat with those districts which are decidedly not deserts, *e. g.*, the neighbourhood of Laredo from El Paso to S. Antonio in New Mexico, Fresno, Bernalillo and Los Angeles in California.

CNEMIDOPHORUS MULTISCUTATUS Cope, based upon four specimens from Cedros Island, West Coast of Lower California, can scarcely claim distinctive rank.

Cope gives the following data:—Length 85 mm. Humerus with 7–8 rows, but he adds that this number is not quite constant, one specimen having but 6 rows. Femoral rows 8–9, but I fail to count even 8 in Cope's figure. Pores 20–22. Throat and collar with transverse black spots and bands; tail with black spots below; "belly black and light olive mixed." Dorsal coloration like that of the *C. gracilis* stage of *C. tessellatus*. He adds that he caught a specimen structurally exactly like this *multiscutatus* near Pyramid Lake in Western Nevada. This, coupled with the fact that Cope himself records four specimens of the typical *C. tessellatus* from Cedros Island, restricts the supposed differences of his *C. multiscutatus* to a mere individual variation.

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* To none of these stages applies *C. guttatus* Hallowell, as Cope would have it. Hallowell distinctly states that the subgular fold is margined with a row of large smooth scales.

Further, a specimen (text-fig. 64 A) obtained by Dr. Meek at El Paso fits exactly the *C. tessellatus multiscutatus*. Length 93 mm. Humerus with 7 to 8 scales; femur with 7; pores 22/20. The throat and collar are pale blue, both with scattered jet-black spots. Chest white, with scattered black spots. Belly white to greenish yellow, here and there with half a black scale. Thighs below greenish yellow; tail below with blackish spots. Dorsal surface of black ground-colour with 4 pairs of light stripes, of which the first is broken up into yellow spots and bars, while the others are partly broken and zigzag. On the shoulders and neck the general colour is grey with about six rows of black spots, while the last traces of the former pale stripes are completely lost. Thighs above and behind with large greenish-yellow spots on bluish ground.

As a peculiarity I mention in this specimen the existence of three enlarged scales across the lower eyelid, exactly as those figured by Cope, p. 584, in *tessellatus rubidus*. The artist no doubt saw correctly, but the author does not mention this peculiar arrangement.

CNEMIDOPHORUS MAXIMUS Cope.

From Lower California: Cape St. Lucas, La Paz, and the little island of Espirito Santo. "The largest species of the genus"; Boulenger returns the largest as of 120 mm.

Humeral rows 4–5 in Cope's key, p. 568, but in the text, p. 571, are stated 6–8. Anterior surface of forearm with 4 rows; posterior surface granular, but according to the figure with slightly enlarged granules on mid-arm. Femur with 7 rows; but in the figure I should certainly count 9. Pores 24–25; in the figure only 21 or 22. The young are said to have a median light stripe and two paired stripes on blackish ground. Each of the fields with two rows of pale spots. The adult are olive-brown with three brown stripes on each side as broad as the fields, "and so broken by spots of the ground-colour as to resemble series of confluent brown variations." "Gular region blackish varied; abdominal shields black-tipped."

Apparently these specimens from the southern part of Lower California constitute a large, coarsely marbled, and rather dull-coloured race of *C. tessellatus*.

CNEMIDOPHORUS RUBIDUS Cope.

From S. Margarita Island, West Coast of Lower California. Length 100 mm. Humeral rows 5–6; femoral rows 8–9. Pores 22.

The young have traces of six stripes on light brown ground, and the fields are cross-barred with olive and black, as in the adult of *C. gularis mariarum*.

The adults have the upper parts dove-brown, with three rows of more or less obsolete black spots on the back, and vertical bars on the sides. There are no light stripes. The throat is spotted with black; the chest and belly are straw-coloured, tinged with green, and varied with black and red, the pale scales being black-edged. The under surface of the thighs, hands and feet, and of the distal half of the tail is bright vermilion.

This race presents an unmistakable desert type, verging as it does towards the monochrome condition, with few dark spots.

The isolated occurrence of these lizards, and their bright-coloured under parts, combined with the comparatively large number of pores, femoral and humeral scales, justify their subspecific rank to *C. tessellatus*, with which they are closely allied.

CNEMIDOPHORUS MELANOSTETHUS Cope=*variolosus* Cope.

The types of *melanostethus* in the Smithsonian Mus. are from the Lower Colorado River, others from Tucson and Fort Lowell in Arizona. The single type of *C. variolosus* is from Parras in Coahuila. Dr. Meek brought identical specimens from Lerdo in Nuevo Leon. These four localities lie in an almost straight line.

This small species measures, adult, from 62 to 86 mm. Its most striking character is the coloration: black-blue under parts; upper parts bluish, all over vermiculated and spotted with white.

The following description refers to a male and a female specimen from Lerdo:—4 supraoculars, with granules behind. No frenocular. Collar composed entirely of very small scales, and granules in several rows from the edge of the collar. Humerus of the male with 3 large and 3 smaller rows; of female with 5 large and 1 smaller row.

Front of forearm: male with 3 complete very regular rows; female with 3 very irregular rows. Posterior side of arm entirely granular. Femur with 6 to 7 rows. Tibia with 2 large and 1 or 2 smaller rows. Preanal isthmus with 2–3 rows of small scales.

Pores: male 22/23; female 23/25. Two specimens from Fort Lowell have 18/19 and 21 pores. Cope's type-specimen from Coahuila is said to have 25 pores (pp. 568, 587), but the figure on p. 588 shows only 20. The hind limb of the typo is said to reach the prenasal plate. That of the Lerdo male reaches between ear and eye; that of the female reaches the posterior angle of the eye.

Coloration of male: Throat blue, collar and chest black; abdomen black with white edges to the scales; tail below much speckled with black-blue. Female: Throat, collar, and chest blue; abdomen blue with white-edged scales; thighs blue and white; tail mostly blue.—Upper surface: bluish ground-colour, all vermiculated and spotted with yellowish white; in the female without traces of stripes, while in the male stripes 2 and 3 are still discernible. In a female specimen from Fort Lowell, British Museum, 70 mm., with eggs, stripe 1 is nearly gone, while stripes

2 and 3 are still present, but grey; fields still with double rows of numerous spots; throat mottled.

Cope, who had many specimens from the Colorado River, adds that the young have two pairs of narrow stripes, that the fields between them show a row of pale spots, and that the thorax is not black. The adult he describes as having about 14 rows of grey-yellow spots on grey-olive ground.

In colour and pattern of the upper parts, this species strikingly resembles the *C. scalaris* of the *C. gularis*-group; on the other hand, the mottled throat of the Ft. Lowell female and the dorsal striation show that *C. melanostethus* is a smaller and nigrescent form closely allied to *C. tessellatus*.

CNEMIDOPHORUS MARTYRIS Stejneger = *æthiops* Cope.

From San Martyr Island in the Gulf of California, and from Hermosillo in Sonora. Length 82 mm.

Humerals 4–5; femorals 6–7; pores 20–21.

Immature, or females?: with 7 narrow stripes, which are a little paler than the ground-colour; fields obscurely spotted, but one of the females has the fields spotless and black; under parts white, throat and collar dusky. Old specimens are black above and below, except the hind limbs and the ventral line of the tail. The posterior side of the thighs is marked with three black longitudinal stripes.

The following two species are based upon very insufficient material, possibly young specimens.

They belong without any doubt to the *tessellatus*-group.

CNEMIDOPHORUS OCTOLINEATUS Baird.

The single specimen, from Pesqueria Grande in Nuevo Leon, measures 60 mm. Bluish olive, darker above, lighter below; with 8 pale narrow stripes of the same tint; without any spots on body, tail, or limbs. Humeral rows of scales 5, femorals 6, tibials 3. Pores 17. Scales of the back depressed.

CNEMIDOPHORUS INORNATUS Baird.

Two specimens, from Pesqueria Grande, Nuevo Leon, of 56 mm. Uniform dark olivaceous above, pale olivaceous below; without spots or stripes. Scales of the back tubercular and elevated. Humerus with 6 rows. Femur with only 4 or 5 rows according to Cope, but I count 6 very regular rows in the figure on p. 591. Pores 16–17.

I am inclined to think that these are very young specimens. Cope remarks that "it is the smallest species, and yet shows no indication of stripes." However, in very young examples of *C. guttatus*, the spotted and dull-coloured forest-variety of *C. immutabilis*, the stripes are frequently at first so very faint that they are visible only in certain lights, and they appear only later as stripes, soon to be broken up and to partly vanish again.

CNEMIDOPHORUS LABIALIS Stejneger.

Based upon five specimens from Cedros Island, Lower California.

Distinguished from all the other *Cnemidophori* by the nasal being n contact with the second upper labial, which latter completely separates the postnasal from the first labial. Supraoculars 4, but in the figure given by Cope the 4th or posterior supraocular is broken up into two or three smaller scales; a condition which may be an individual abnormality, but which also is shown in the figures of *C. sericeus* and *semifasciatus*. The collar, to judge from the figure, is composed of decidedly small scales, only those of the middle being somewhat larger; all the scales, however, form the posterior sharp margin of the collar, there being no granules. The posterior surface of the forearm is covered with granules, about three rows of which are slightly enlarged. Femoral rows 5, or only 4. Pores 12 to 13. Only two large preanal plates, the usual posterior pair being fused into one broad plate. Total length 55 mm.

"Colour above dark brown, with six longitudinal light lines and a median clay-coloured band of the same shade as the top of the head; two light longitudinal lines on fore limbs and three on hind limbs; under side whitish, more or less suffused with bluish, especially on the flanks."

This little species is very puzzling. The arrangement of the labials and nasals is unique. The condition of the collar is essentially that of the *tessellatus*-group, but recalling the *gularis*-group by the sharp edge without granules. However, a very similar collar is given to *C. octolineatus* and *C. inornatus* in Cope's figures. The slightly enlarged granules on the forearm point to *C. deppei* and to *C. sexlineatus*, which latter is, moreover, closely approached by the colour-pattern. The three peculiar pale stripes on the hind limb recall the equally peculiar three black stripes of *C. martyris*.

References to the original descriptions of species of Cnemidophorus.

C. sexlineatus Linné, Syst. Nat. xii. 1766, p. 364.

DEPPEI-Group.

C. guttatus Wiegm. Herpetolog. Mexicana, 1834, p. 29.
  =*microlepidopus* Cope, Proc. Am. Phil. Soc. xvii. 1877, p. 93.
  =*unicolor* Cope, ibid.
C. deppei Wiegm. Herp. Mexic. 1834, p. 28.
  =*decemlineatus* Hallowell, Proc. Ac. Philad. 1860, p. 482.
  =*lineatissimus* Cope, Proc. Am. Phil. Soc. 1877, p. 94.
  =*alfaronis* Cope, Proc. Ac. Philad. 1894, p. 199.
C. immutabilis Cope, Proc. Am. Phil. Soc. 1877, p. 93.
  =*C. guttatus* var. *striata* Gadow, Proc. Roy. Soc. 1903, p. 155.

GULARIS-Group.

C. gularis Baird & Girard, Proc. Ac. Phil. 1852, p. 128.
=*guttatus* Hallowell, nec Wiegm. op. cit. 1854, p. 192.
C. mexicanus Peters, Monatsb. Berl. Ak. 1869, p. 62.
C. gularis communis Cope, Proc. Am. Phil. Soc. 1877, p. 95; 1886, p. 283.
C. angusticeps Cope, ibid. 1877, p. 95.
?*C. costatus* Cope, ibid. 1877, p. 95.
C. mariarum Günther, Biol. C.-Americ., Rept. p. 28.
C. sexlineatus var. *bocourti* Blgr. Cat. Liz. ii. 1885, p. 367.
C. gularis scalaris Cope, Americ. Naturalist, 1891, p. 1135; Trans. Am. Phil. Soc. 1892, p. 47.
C. gularis semifasciatus Cope, Trans. Am. Phil. Soc. 1892, p. 49.
=*C. g. sericeus* Cope, op. cit. p. 48.
C. septemvittatus Cope, op. cit. 1893, p. 40.

TESSELLATUS-Group.

Cnemidophorus (*Ameiva*) *tessellatus* Say, Long's Exp. Rocky M. ii. 1823, p. 50.
=*C. gracilis* Baird & Girard, Proc. Ac. N. Sc. Philad. 1852, p. 128.
=*C. tigris*[*], Baird & Girard, ibid. p. 69.
=*C. tessellatus multiscutatus* Cope, Trans. Am. Phil. Soc. 1892, p. 38.
C. stejnegeri Van Denburgh, Proc. Cal. Ac. Sci. 1894, p. 300.
C. perplexus Baird & Girard, Proc. Ac. N. Sc. Phil. 1852, p. 128.
C. grahami Baird & Girard, ibid. 1852, p. 128.
C. octolineatus Baird & Girard, ibid. 1858, p. 255.
C. inornatus Baird & Girard, ibid. 1858, p. 255.
C. maximus Cope, ibid. 1863, p. 104.
C. melanostethus Cope, ibid. 1863, p. 104.
=*C. tessellatus variolosus* Cope, Trans. Am. Phil. Soc. 1892, p. 39.
C. labialis Stejneger, Proc. U.S. Nat. Mus. 1889, p. 643.
C. martyris Stejneger, ibid. 1890, p. 407.
=*æthiops* Cope, Report U.S. Nat. Mus. for 1898, p. 582.
C. tessellatus rubidus Cope, Trans. Am. Phil. Soc. 1892, p. 36.

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[*] Peters has remarked that *C. tigris* B. & G. is "undoubtedly" =*C. sackii* Wiegm. Herpetol. Mexic. 1834, p. 29. I have been able to corroborate this, by examination of the type-specimen in the Berlin Museum. This synonymy does not apply to the three specimens collected by Sallé at Oaxaca, determined by Bocourt as *C. sexlineatus* var. *sackii*, Wiegm.

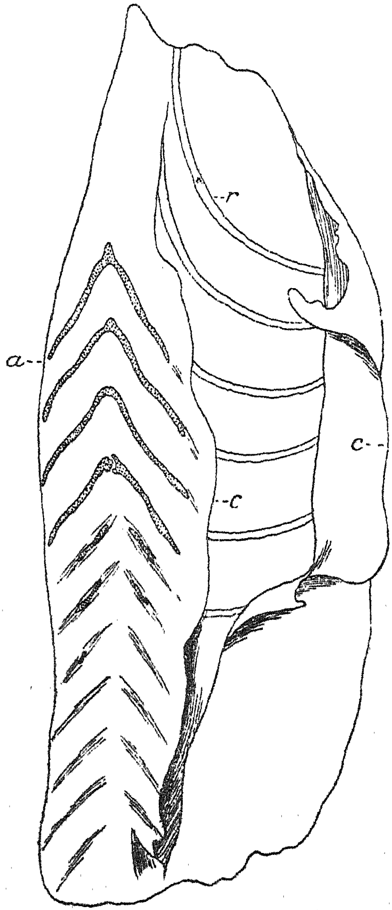
April 10, 1906.

Herbert Druce, Esq., Vice-President, in the Chair.

Mr. F. E. Beddard, F.R.S., exhibited a partially dissected specimen of the Scincoid Lizard *Trachysaurus rugosus*, and made the following remarks:—

The existence of a *parasternum* ("abdominal ribs") is more obvious for purposes of demonstration in this Lizard than

Text-fig. 84.



Portion of ventral surface of *Trachysaurus rugosus*.
a, abdominal ribs; *c*, cut edge of superficial abdominal muscles; *r*, ribs.

Tiliqua scincoides, in which species I have recorded * the structure in question as I believe for the first time; for the elements are larger and more thoroughly chondrified, and thus more easily distinguishable from the tendinous intersections of the abdominal muscles in which they lie than in *Tiliqua*, as will be seen in the figure (text-fig. 84). When the outermost layer of the abdominal musculature is raised from the deeper layer, the abdominal ribs are raised with the former and can thus be seen to overlie the true ribs which occur in the deeper layer of the ventral musculature.

Three pairs of abdominal ribs meet in the middle line and thus form a series of three chevrons. The first two of these possess a forwardly-directed process of the triangular plate which forms the region where the two ribs of the pair are fused. Behind these comes one pair of abdominal ribs, which does not—but only just does not—meet in the middle line. A fifth and sixth rudimentary pair exists; there is a true rudiment on the right side of a seventh abdominal rib. Behind this only the tendinous intersections of the abdominal muscles are visible. In the region of the parasternum the true ribs do not reach the middle line as cartilaginous rods, and, as already mentioned, they are overlapped by the gristly rods of the parasternum. As Prof. Parker has pointed out †, there are five pairs of true ribs attached to the sternum in *Trachysaurus*. He does not, however, mention that a pair behind these also meet and fuse in the middle line a little way behind the sternum. These true ribs meet and fuse superficially and exactly resemble the succeeding abdominal ribs, so far as the median region is concerned. This, however, can invalidate no homology, for the exposure of a true additional piece of xiphisternum is simply due to the absence of pectoral muscles; and in any case the remaining pieces of cartilage so entirely overlap so considerable a portion of the true ribs that they cannot possibly be regarded as the equivalent of their median ventral extremities, which, indeed, themselves reach to within a millimetre or two of the ventral middle line.

Mr. R. I. Pocock, F.Z.S., exhibited the skull of a Horse to show the preorbital pit, and made some remarks upon the occurrence of this feature in the skulls of extinct and existing Equidæ, and commented on its supposed homology to the præorbital pit of *Hipparion* and upon the systematic value that has been attached to it.

The following papers were read:—

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* "On the Presence of Parasternum in . . . *Tiliqua*, &c.," P. Z. S. 1904, vol. ii. p. 154.

† Monograph on Shoulder-Girdle, Ray Soc. 1868 p. 114.

1. On the Fresh-water Fishes of the Island of Trinidad, based on the collection, notes, and sketches made by Mr. Lechmere Guppy, Junr. By C. TATE REGAN, B.A., F.Z.S.

[Received January 26, 1906.]

(Plates XXI.–XXV.*)

The Fresh-water Fishes of the Island of Trinidad, West Indies, formed the subject of an important memoir by Dr. Th. Gill † in 1858. The following is a list of the species which he described, together with the names used to designate them in the present paper:—

Polycentrus tricolor *Gill* = Polycentrus schomburgkii.
Ctenogobius fasciatus *Gill* = Gobius fasciatus.
Cychlasoma pulchrum *Gill* = Acara pulchra.
„ tænia *Benn.* = Cichlosoma bimaculatum.
Crenicichla frenata *Gill* = Crenicichla saxatilis.
Pimelenotus wilsoni *Gill* = Pimelodus wilsoni.
Callichthys kneri *Gill* = Callichthys kneri.
Hoplosternum lævigatum *Val.* = „ littoralis.
„ stevardii *Gill* = „ thoracatus.
Hoplosoma æneum *Gill* = Corydoras æneus.
Hypostomus robinii *C. & V.* = Plecostomus guacari.
Ancistrus guacharote *C. & V.* = Ancistrus trinitatis.
Macrodon ferox *Gill* = Macrodon trahira.
Erythrinus cinereus *Gill* = Erythrinus unitæniatus.
Pœcilurichthys brevoortii *Gill* = Tetragonopterus maculatus.
„ tæniurus *Gill* = „ tæniurus.
„ pulcher *Gill* = Chirodon pulcher.
„ unilineatus *Gill* = Tetragonopterus unilineatus.
Curimatus argenteus *Gill* = Curimatus argenteus.
Stevardia albipinnis *Gill*
Corynopoma riisei *Gill*
„ veedonii *Gill* } = Corynopoma riisii.
Nematopoma searlesii *Gill*

In Dr. Günther's Catalogue of Fishes (1859–1870) a little Cyprinodont was described from Trinidad under the name *Girardinus guppyi* ‡, and in 1873 and 1874 the late Prof. Lütken § published some critical notes on the Siluroid and Characinid fishes described by Dr. Gill.

The present paper deals with a collection made by Mr. Lechmere Guppy, Junr., who has followed out a suggestion made by Mr. Boulenger to such good purpose that he has sent to the British Museum a series of well-preserved specimens representing thirty-five species, including all but three of those which have previously been described from the island. He has also sent

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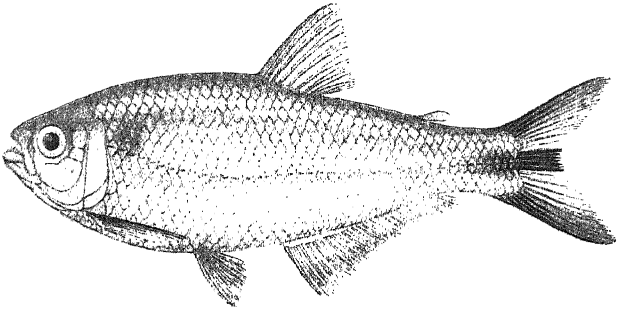
* For explanation of the Plates, see p. 393.

† Ann. Lyc. N. York, vi. pp. 363–430.

‡ This species was named after Mr. L. Guppy, Senr.

§ Vid. Medd. Kjöbenhavn, 1873, pp. 214–217, and 1874, pp. 220–240.



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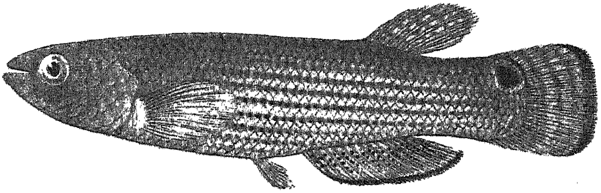

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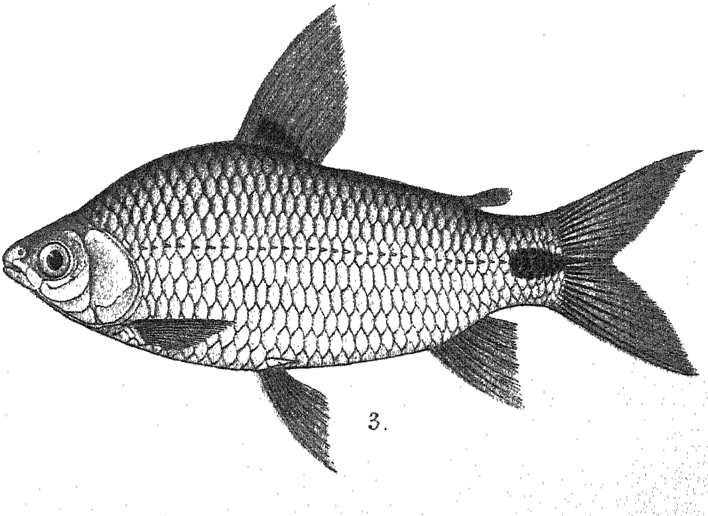
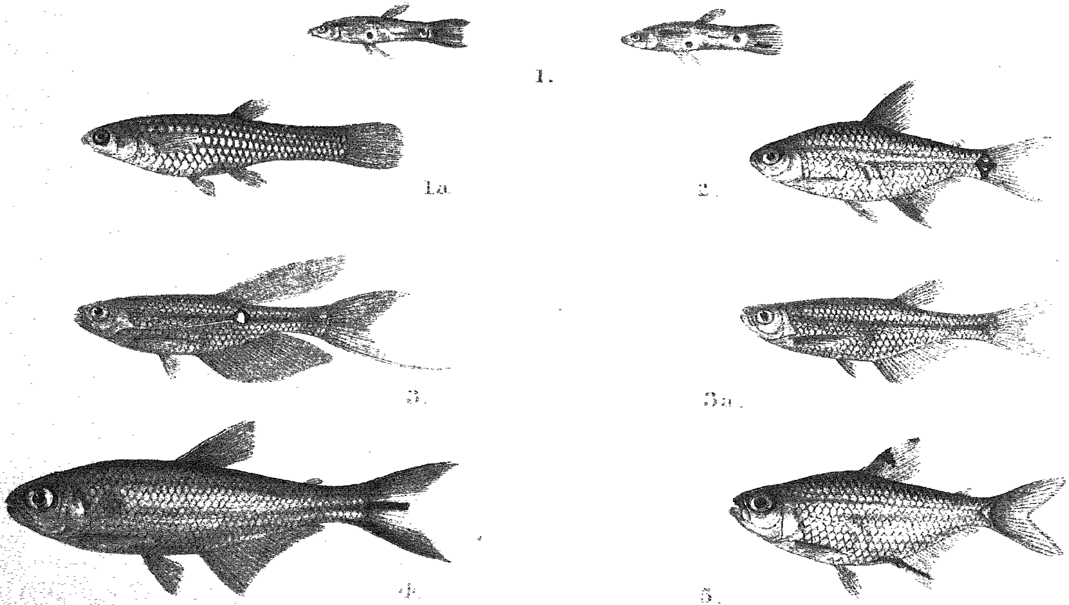


3.

L. Guppy pinxt.

J. Green del. et Chromo lith.

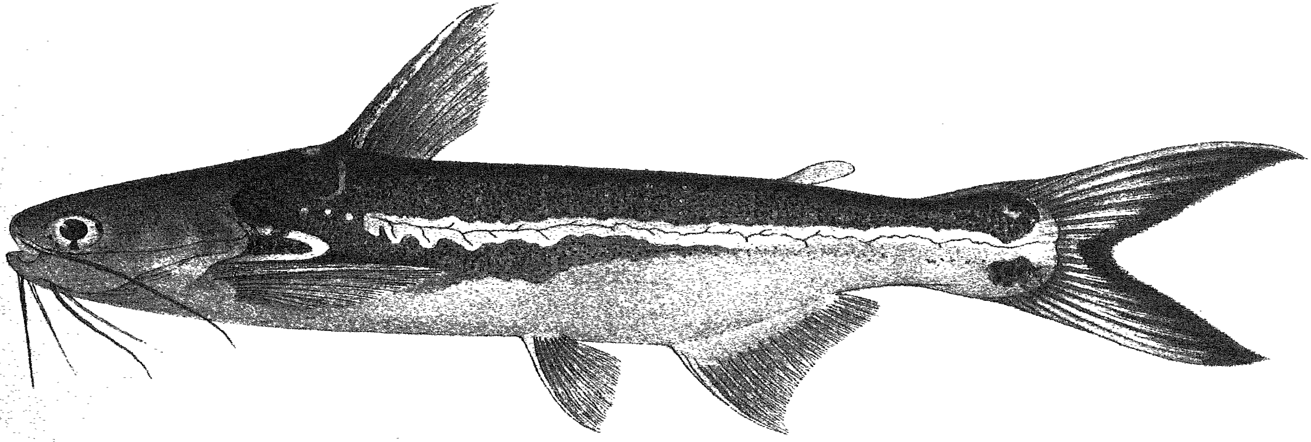
1. TETRAGONOPTERUS GUPPYI. 2. HAPLOCHILUS HARTI.
3. CURIMATUS ARGENTEUS.



L. Guppy pinxt.

J. Green del. et [illegible] lith.

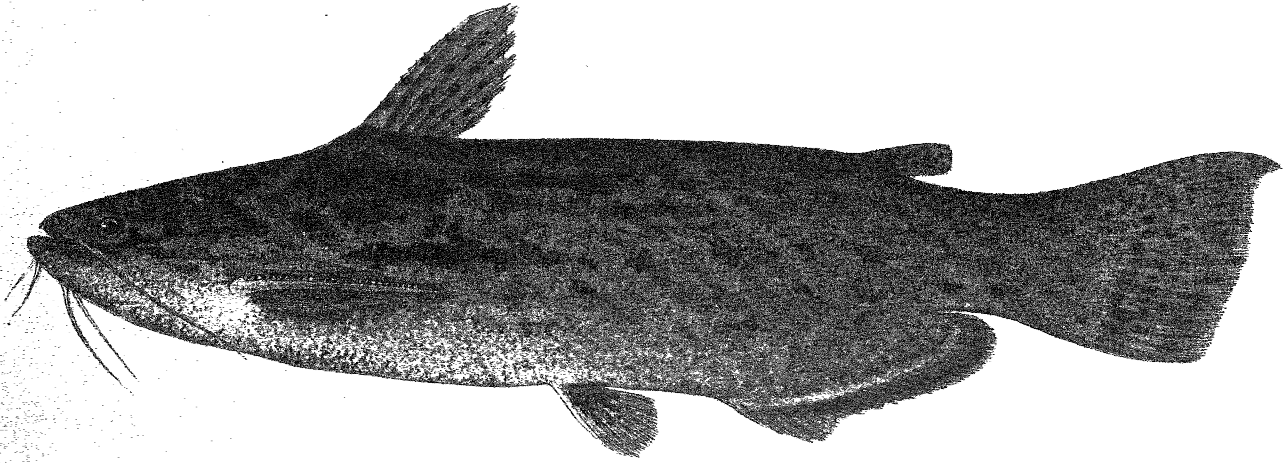
1. GIRARDINUS GUPPYI. ♂. 1a. ♀. 2. CHIRODON PULCHER. 3. CORYNOPOMA RIISEI ♂ & 3a ♀.
4. TETRAGONOPTERUS TAENIURUS. 5. T. UNILINEATUS.



L. Guppy pinxt.

J. Green del. et Chromo lith.

PARAUCHENIPTERUS PASEAE.



L. Guppy pinxt.

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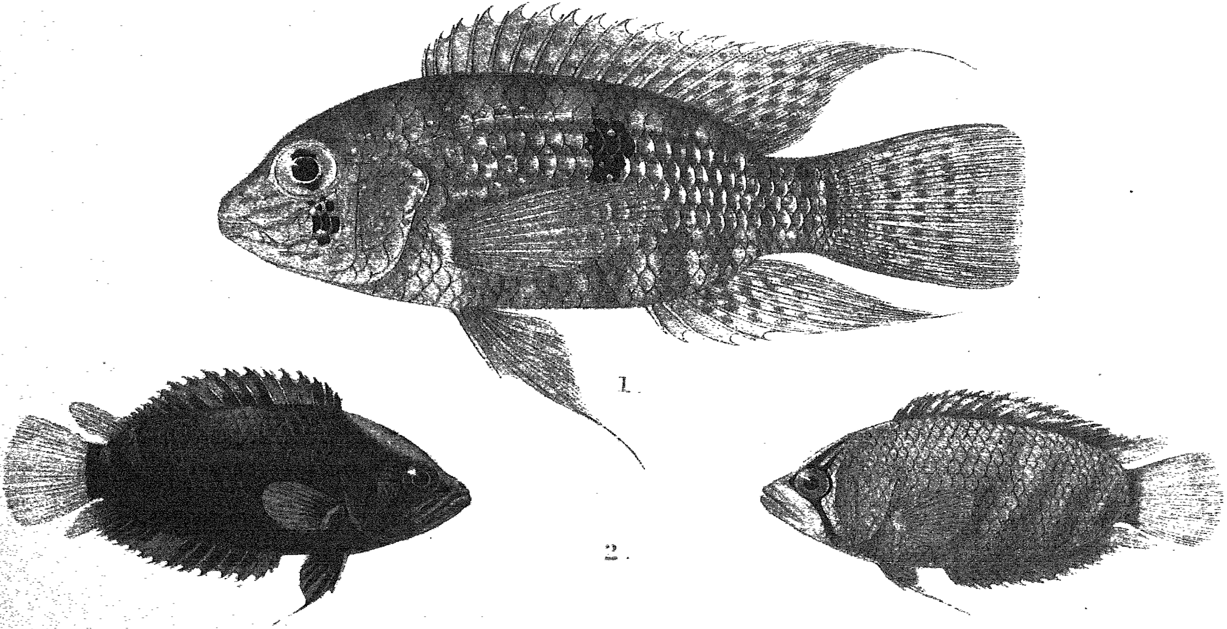
PSEUDAUCHENIPTERUS GUPPYI.



L. Guppy pinxt.

J. Green del. et Chromo lith.

1. ACARA PULCHRA. 2. POLYCENTRUS SCHOMBURGKII.

notes on the habits and the life-coloration of these fishes, and a set of beautifully executed water-colour drawings made by himself, some of which have been reproduced by Mr. Green to illustrate this paper.

Mr. Guppy's collecting was done in the northern part of the island, and most of the fish were taken on the Streatham Lodge Estate in muddy streams draining into the Caroni River, flowing through narrow ravines in which there is a considerable growth of rank grass. In times of drought these streams form a series of almost isolated pools. The Caroni River has a fair current; during heavy rains it overflows its banks and the surrounding country is swamped; floods extending for miles round sometimes occur in the wet season, the egress of water from the river being checked by the high tides caused by the quantity of water poured into the Gulf of Paria by the Orinoco.

Mr. A. J. Pasea, of Streatham Lodge Estate, accompanied Mr. Guppy on all his expeditions, put his seine nets and trained labour at his disposal, and gave him the benefit of his experience as to the best localities to fish in, while Mr. Balfour, of Frederick Estate, lent him a boat for use on the Caroni. Assistance was also given in various ways by Dr. Tulloch, Sir C. C. Knollys, the Hon. S. W. Knagg, and Sir A. Maloney. To all of these gentlemen, and especially to Mr. Pasea, Mr. Guppy wishes to express his gratitude.

I have prepared a key to the fishes which have so far been recorded from the fresh-waters of Trinidad, and I follow it with a list arranged in systematic order, with extracts from Mr. Guppy's notes, and with full descriptions of those species which are not well known. Whenever possible I have placed the extracts from Mr. Guppy's notes in inverted commas.

Synopsis of the Species of Fresh-water Fishes so far recorded from Trinidad.

I. Body scaly; ventral fins present, abdominal; fins without spines.
  A. No adipose fin.
    1. Mouth small; teeth unicuspid.
Anal fin with 15–17 rays .... 25. *Haplochilus harti.*
Anal fin with 8–9 rays .... 26. *Girardinus guppyi.*
    2. Mouth large; teeth conical.
Dorsal fin with 13–15 rays. 38–40 scales in a longitudinal series .... 1. *Macrodon trahira.*
Dorsal fin with 10–11 rays. 32–33 scales in a longitudinal series .... 2. *Erythrinus unitæniatus.*
    3. Mouth small; teeth compressed, notched or denticulated.
3. *Corynopoma riisii.*
  B. An adipose fin.
    1. Teeth well developed, compressed, notched or denticulated.
      a. Præmaxillary teeth in a double series.
        α. Lateral line complete.
          * Depth of body 3–3⅓ in the length.
Diameter of eye ⅖ the length of head (in specimens of 60–65 mm.) .... 4. *Tetragonopterus tæniurus.*
Diameter of eye $\frac{2}{7}$–⅓ the length of head (in specimens of 65–85 mm.) .... 5. *T. guppyi.*

** Depth of body 2–2⅔ in the length 6. *T. maculatus.*
β. Lateral line wanting posteriorly ... 7. *T. unilineatus.*
b. Præmaxillary teeth in a single series . 8. *Chirodon pulcher.*
2. Teeth wanting .... 9. *Curimatus argenteus.*

II. Body elongate, scaly; no ventral fins; no dorsal; anal very long....................................... 10. *Carapus fasciatus.*

III. Body naked or with bony plates ventral fins present, abdominal; an adipose fin.

A. Body naked; adipose fin normal.

1. Gill-membranes with free posterior edge, not united to the isthmus.

a. Adipose fin short.

Teeth on the palate in two small separate patches. 11. *Arius spixii.*
Teeth on the palate forming a broad continuous band. 12. *A. herzbergii.*

b. Adipose fin very long .... 13. *Pimelodus wilsoni.*

2. Gill-membranes broadly united to the isthmus.

Caudal fin deeply forked .... 14. *Pseudauchenipterus guppyi.*
Caudal fin obliquely truncate .... 15. *Parauchenipterus paseæ.*

B. Body covered on each side with 2 series of lamellæ, overlapping on the mid-lateral line; adipose fin with a movable spine.

1. Two pairs of nuchal plates between parieto-occipital and basal shield of spine of dorsal fin.

a. Coracoids not exposed on ventral surface. 16. *Callichthys kneri.*

b. Coracoids exposed ventrally.

A median series of plates extending the whole of the distance from dorsal to adipose fin .... 17. *C. littoralis.*
A median series of plates in front of the adipose fin, not extending forward to the dorsal......................... 18. *C. thoracatus.*

2. Parieto-occipital produced into a process which reaches the basal shield of the spine of dorsal fin. 19. *Corydoras æneus.*

C. Body covered on each side by 4 or 5 series of bony plates; adipose fin with a movable spine.

1. Upper surface of snout covered with small granular plates.

a. Interoperculum little movable, not notably spinate or bristly.

Eye moderate; snout ovate .... 20. *Plecostomus guacari.*
Eye small; snout broadly rounded .... 21. *P. robini.*

b. Interoperculum freely movable, with a bunch of slender spines with hooked apices, which can be everted .... 22. *Ancistrus trinitatis.*

2. Upper surface of snout naked, bearing prominent fleshy tentacles in the males .... 23. *Xenocara cirrhosum.*

IV. Body elongate, eel-shaped, naked; no paired fins; gill-openings represented by a single ventral slit. 24. *Symbranchus marmoratus.*

V. Body elongate, enclosed in a series of bony rings; no ventral fins; snout produced, tubiform .... 27. *Doryichthys lineatus.*

VI. Body scaly; anterior part of dorsal fin formed of spines or a separate anterior dorsal formed of spines or of simple flexible rays.

A. Ventrals separate, each formed of an outer spine and of five branched rays.

1. A single dorsal fin.

Dorsal XVI–XVIII 7–8. Anal XIII–XIV 7–8... 33. *Polycentrus schomburgkii.*
Dorsal XVII–XX 13–16. Anal III 8–10 .... 34. *Crenicichla saxatilis.*
Dorsal XIII–XIV 9–11. Anal III 7–9 .... 35. *Acara pulchra.*
Dorsal XIV–XV 9–11. Anal IV 8–9 .... 36. *Cichlosoma bimaculatum.*

2. Two dorsal fins.
  a. Anterior dorsal of 4 spines.
    α. Jaws with bands of small pointed teeth.
28. *Agonostomus monticola.*
    β. Jaws with minute ciliiform teeth *; anal fin usually with III 8 rays; 32 to 36 scales in a longitudinal series.

Second dorsal with a series of small scales behind each ray, otherwise naked .... 29. *Mugil brasiliensis.*
Second dorsal covered with small scales .... 30. *M. trichodon.*

  b. Anterior dorsal of 7 or 8 spines; anal with 3 spines, the second and third strong †.

65–75 scales in a longitudinal series; second and third anal spines subequal .... 31. *Centropomus undecimalis.*
50–60 scales in a longitudinal series; second anal spine considerably longer than third .... 32. *C. ensiferus.*

  c. Anterior dorsal of 6 or 7 slender flexible spines; anal with a single feeble spine ‡.

Vomer toothed; lower jaw projecting; scales small.
37. *Philypnus dormitator.*
Vomer toothless; jaws equal anteriorly; scales rather large.
38. *Dormitator maculatus.*

B. Ventrals united to form a disc.
  1. Jaws with bands of small pointed teeth and an outer series of larger teeth.

32 scales in a longitudinal series........................ 39. *Gobius fasciatus.*
60–75 scales in a longitudinal series .... 40. *Chonophorus banana.*
  2. Teeth in the jaws in a single series ...... 41. *Evorthodus breviceps.*

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* Although only *M. brasiliensis* and *M. trichodon* have been actually recorded from Trinidad, there can be but little doubt that all the species of *Mugil* which occur on the Atlantic coasts of America are to be obtained there.

These may be distinguished as follows:—

I. Second dorsal naked except for a series of small scales behind each ray; anal with III 8 rays (rarely III 7 or III 9).

38 to 42 scales in a longitudinal series .... *cephalus* L.
32 to 36 scales in a longitudinal series .... *brasiliensis* Ag.

II. Second dorsal covered with small scales.
  A. Anal with III 9 rays (rarely III 8).

42 to 45 scales in a longitudinal series .... *incilis* Hancock.
36 to 39 scales in a longitudinal series .... *curema* C. & V.

  B. Anal with III 8 rays (rarely III 7 or III 9); 32 to 36 scales in a longitudinal series .... *trichodon* Poey.

† Probably all the Atlantic species of *Centropomus* occur in the rivers of Trinidad. They may be distinguished thus:—

I. Anal with III 7 rays, the second and third spines subequal.
pectinatus Poey.

II. Anal with III 6 rays.
  A. Second and third anal spines subequal; 65 to 75 scales in a longitudinal series............................ *undecimalis* Bl.
  B. Second anal spine longer than third.

75 to 90 scales in a longitudinal series .... *parallelus* Poey.
50 to 60 scales in a longitudinal series .... *ensiferus* Poey.

‡ Allied to *Philypnus dormitator* and certainly to be found in the rivers of Trinidad are two species which may be distinguished thus:—

Vomer toothless; lower jaw projecting; scales small.
Dorsal with VI, I 8 rays .... *Eleotris pisonis* Gm.
Dorsal with VII, I 10 rays .... *E. guavina* C. & V.

1. MACRODON TRAHIRA Spix.

"Guabin."

"Much appreciated as an article of food, although rather bony; they are purchased readily by the labouring classes.

"A very small specimen (30 mm.) was caught at Cumuto; it was skimming along the top of the water when captured. Examples of this size can vibrate the pectoral fins with extreme rapidity; they often rest as if asleep, hence the name 'Dormeuse.'

"Colour: greenish, a more or less distinct blackish longitudinal band and irregular cross-bars; vertical fins with series of dark spots."

Hab. Brazil; Guiana; Venezuela.

2. ERYTHRINUS UNITÆNIATUS Spix.

"Yarrow."

"Found all over the island in muddy streams.

"Colour: greenish or olivaceous; sometimes a dark longitudinal lateral stripe; fins pink."

Hab. Brazil; Guiana; Venezuela.

Genus CORYNOPOMA.

Stevardia Gill, Ann. Lyc. N. York, vi. 1858, p. 424.

Corynopoma Gill, t. c. p. 425; Günth. Cat. Fish. v. p. 287 (1864).

Nematopoma Gill, t. c. p. 428.

This genus appears to be allied to *Tetragonopterus*, from which it differs in the more posterior position of the dorsal fin, the absence of an adipose fin, and in the curious sexual characters.

3. CORYNOPOMA RIISII. (Plate XXII. fig. 3.)

Stevardia albipinnis Gill, Ann. Lyc. N. York, vi. 1858, p. 425.

Corynopoma riisei Gill, t. c. p. 426; Günth. Cat. Fish. v. p. 287 (1864); Lütken, Vid. Med. 1874, p. 223.

Corynopoma veedoni Gill, t. c. p. 427; Günth. l. c.

Nematopoma searlesii Gill, t. c. p. 429.

Corynopoma albipinnis Günth. l. c.

Corynopoma searlesii Günth. t. c. p. 288; Lütk. l. c. fig.

Body compressed, subfusiform, the depth $3-3\frac{1}{2}$ in the length, the length of head $4\frac{1}{4}-4\frac{3}{4}$. Snout much shorter than eye, the diameter of which is $2\frac{1}{3}-2\frac{1}{2}$ in the length of head and nearly equal to the interorbital width. Mouth small, very oblique, the maxillary nearly vertical, just in front of the eye. Teeth compressed, with strong median cusp and 1 to 3 smaller cusps on each side, in 2 series in the upper jaw, 1 in the lower. Operculum, in the female, with a short pointed projection; in the adult male with a long, slender, curved process terminating in a compressed expansion at the level of the dorsal fin. Scales 38–44 $\frac{6-7}{7-8}$, 5 or 6 between lateral line and root of ventral; lateral line complete. Dorsal 9–11, commencing above about the seventh anal ray; when laid back, in the female not nearly reaching the caudal, in the adult male extending well beyond the base of caudal. Anal 25–30, commencing at or a little behind the middle of the length of the fish; last ray, when laid back, in the female not reaching the caudal, in the adult male extending well beyond the base of the caudal. Pectorals and ventrals extending to or nearly to the origin of anal; ventrals 7-rayed. Caudal deeply forked, the lobes equal in the female, the lower considerably produced in the adult male. Caudal peduncle $1\frac{2}{3}$–2 as long as deep. Olivaceous, with silvery reflections; a blackish stripe along the middle of the side; fins pale.

14 examples, measuring up to 45 mm. in total length.

The genus *Stevardia* was founded either on females or on very young males, with the operculum ending in a short pointed process and the fins not produced. *Corynopoma* included males of small size, with the opercular process short and the fins moderately produced, whilst *Nematopoma* was for the fully developed males. Lütken pointed out that these supposed generic differences were to be found in examples of the same species, according to the size of the specimen taken. These changes are now found to be confined to the males, and I see no reason to believe that more than one species has formed the basis of Dr. Gill's descriptions. This genus has only been recorded from Trinidad.

"The 'Swallow-tailed Sardine' is fairly plentiful in the Tacarigua River. Some have a peculiar pair of 'paddles' attached to the gill-covers, whilst others have no trace of them nor do they have the exaggerated fins which the ones with 'paddles' possess. They are caught in company and are, presumably, the same species. The scales are faintly defined, generally silvery; the back is translucent greenish."

4. TETRAGONOPTERUS TÆNIURUS Gill. (Plate XXII. fig. 4.)

Depth of body 3–$3\frac{1}{3}$ in the length, length of head 4–$4\frac{1}{3}$. Snout much shorter than eye, the diameter of which is $2\frac{1}{2}$ in the length of head and a little greater than the interorbital width. Maxillary extending to below the anterior $\frac{1}{4}$ of eye, with a more or less evident series of small teeth. Scales 38 $\frac{7\frac{1}{2}}{6\frac{1}{2}}$, 5 between lateral line and root of ventral fin; lateral line complete. Dorsal 10, with 8 branched rays, its origin a little nearer to tip of snout than to base of caudal; anterior rays longest, nearly as long as the head. Anal 29–31, with 26 to 28 branched rays. Pectoral extending beyond base of ventral; ventrals originating in advance of the dorsal, extending to the anal. Caudal forked. Caudal peduncle as long as, or a little longer than deep. Olivaceous or greenish above, silvery below; a silvery longitudinal band from operculum to base of caudal; a more or less distinct dark humeral spot; a black longitudinal band on the middle caudal rays, edged with yellow above and below.

Here described from two specimens from Trinidad, 60 and

65 mm. in total length, one received from the Copenhagen Museum as *T. trinitatis**. Gill's description of *T. tæniurus* is, so far as it goes, perfectly applicable to *T. trinitatis*, and there can be but little doubt of their identity. This species is known only from Trinidad.

5. TETRAGONOPTERUS GUPPYI, sp. n. (Plate XXI. fig. 1.)

"Mountain-stream Sardine."

Depth of body $3\text{–}3\frac{1}{3}$ in the length, length of head $4\frac{1}{2}\text{–}4\frac{3}{4}$. Snout shorter than eye, the diameter of which is $3\text{–}3\frac{1}{2}$ in the length of head and less than the interorbital width. Maxillary extending a little beyond the vertical from the anterior margin of eye, with a series of small teeth. Scales $38\text{–}40\,\frac{8\frac{1}{2}}{7\frac{1}{2}\text{–}8\frac{1}{2}}$, $5\frac{1}{2}$ to $6\frac{1}{2}$ between lateral line and root of ventral fin; lateral line complete. Dorsal 10, with 8 branched rays, its origin a little nearer to tip of snout than to base of caudal; anterior rays longest, shorter than the head. Anal 29–32, with 26 to 29 branched rays. Pectoral extending to or a little beyond the base of ventral; ventrals originating in advance of the dorsal, extending nearly to the anal. Caudal forked. Caudal peduncle as long as deep. Silvery, back dark greenish; traces of a dark humeral spot; a blackish longitudinal band on the middle caudal rays; caudal lobes yellow.

Five specimens, 65–85 mm. in total length.

This species is allied to the preceding and also to *T. wappi* Cuv. & Val., which has a much larger head.

"Found in clear pebbly brooks with rapid current and plentiful in the Glenside Estate Stream, at the foot of the Northern Range of hills."

6. TETRAGONOPTERUS MACULATUS L.

"Pink-finned Sardine."

"By far the commonest of the Sardines; they swarm in the Maracas River, which is clear and at times very rapid.

"Colour: Silvery, back darker; a dark humeral spot and a blackish spot at the base of caudal; fins bright pink."

Hab. Brazil; Guiana; Venezuela.

7. TETRAGONOPTERUS (HEMIGRAMMUS) UNILINEATUS Gill. (Plate XXII. fig. 5.)

"Sardine Dorée."

Depth of body $2\frac{1}{2}\text{–}2\frac{3}{4}$ in the length, length of head 4. Snout much shorter than eye, the diameter of which is $2\frac{1}{3}$ in the length of head and slightly greater than the interorbital width. Maxillary extending slightly beyond the vertical from the anterior margin of eye, with a series of minute teeth. Scales $32\text{–}35\,\frac{6\text{–}7}{5\frac{1}{2}\text{–}6\frac{1}{2}}$, $4\frac{1}{2}\text{–}5\frac{1}{2}$ between lateral line and root of ventral fin; lateral line on 9 to 12 scales only, absent posteriorly. Dorsal 10–11, with 8 or 9 branched rays, its origin equidistant from tip of snout and base of caudal; anterior rays longest, nearly as long as the head. Anal 26–30, with 24 to 27 branched rays, produced anteriorly. Pectoral extending beyond the base of ventral; ventrals originating in advance of the dorsal, extending to the anal. Caudal forked. Caudal peduncle as long, or nearly as long as deep. Olivaceous, with silvery reflections; an indistinct stripe from operculum to base of caudal; a blackish spot on the middle of the dorsal fin; an oblique blackish stripe from the origin of anal to the extremity of the third branched ray; dorsal and anal yellowish; caudal pink, with a pale margin.

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* Lütken, Vid. Medd. 1874, p. 234.

Here described from two specimens, 32 and 36 mm. in total length, from Trinidad. This species has not been recorded from other localities.

"Found in drains and ravines in the high woods, Cumuto; they cruise in small shoals."

8. CHIRODON PULCHER Gill. (Plate XXII. fig. 2.)

"Sardine Dorée."

Depth of body $2\frac{1}{2}$–$2\frac{3}{4}$ in the length, length of head $4\frac{1}{2}$–$4\frac{2}{3}$. Snout $\frac{1}{2}$ as long as eye, the diameter of which is $2\frac{1}{2}$ in the length of head, interorbital width $2\frac{1}{4}$. Maxillary extending to the vertical from the anterior margin of eye. Scales 32–34 $\frac{5\frac{1}{2}}{4\frac{1}{2}-5\frac{1}{2}}$, $3\frac{1}{2}$–$4\frac{1}{2}$ between lateral line and root of ventral fin; lateral line complete. Dorsal 11, with 9 branched rays, its origin equidistant from tip of snout and base of caudal; anterior rays longest, longer than the head. Anal 23–25, with 21 or 22 branched rays. Pectoral extending to base of ventral; ventrals originating in advance of the dorsal, extending to or nearly to the anal. Caudal forked. Caudal peduncle as long as deep. Olivaceous; sides silvery or a silvery longitudinal stripe from operculum to base of caudal; an indistinct dark humeral spot; a blackish spot at the base of caudal, posteriorly ending in a point and margined with yellow above and below; dorsal and anal pink.

Four specimens, measuring up to 40 mm. in total length.

This species is known from Trinidad only. Found in drains and ravines in the high woods, Cumuto; they cruise in small shoals.

9. CURIMATUS ARGENTEUS Gill. (Plate XXI. fig. 3.)

"Stout Sardine."

Depth of body $2\frac{1}{2}$ in the length, length of head $3\frac{3}{5}$–4. Snout as long, or nearly as long as eye, the diameter of which is $3\frac{1}{2}$–$3\frac{3}{4}$ in the length of head, interorbital width 2. Maxillary extending to below the nostrils. Scales 36 $\frac{5\frac{1}{2}}{6\frac{1}{2}-7}$, 5 or $5\frac{1}{2}$ between lateral line and root of ventral fin. Dorsal 11, with 9 branched rays, its origin nearer to tip of snout than to base of caudal; anterior branched rays longest, about as long as the head. Anal 9, with 7 branched rays, reaching the base of caudal when laid back. Pectoral extending $\frac{3}{4}$ or more than $\frac{3}{4}$ of the distance from its base to the base of ventral. Ventrals 9-rayed, originating in advance of the vertical from the middle of the dorsal. Caudal forked. Caudal peduncle deeper than long. Silvery; a blackish spot on the caudal peduncle, another on the basal part of the dorsal fin; fins pale yellowish.

Three specimens, 70–100 mm. in total length.

There are examples of this species from Dominica in the British Museum collection, but it has not yet been recorded from other localities.

"Plentiful in the Ravines of the Streatham Lodge Estate."

10. CARAPUS FASCIATUS Pall.

"Cutlass Fish."

"Found in the Bejucal Swamp and Cumuto.

"Colour: head and back dark olive-green; sides with alternate oblique bars of blackish and grey; anal fin blackish; head and body sprinkled with metallic specks."

Hab. Paraguay to Guatemala.

11. ARIUS SPIXII Ag.

"A silver-grey Cat-fish, found in brackish water at the mouth of the river Caroni, where it attains a large size."

Hab. Brazil; Guiana; Venezuela.

12. ARIUS HERZBERGII Bl.

Hab. Brazil; Guiana; Venezuela.

13. PIMELODUS (RHAMDIA) WILSONI Gill.

Depth of body about 5 in the length, length of head $4\frac{1}{4}$–$4\frac{1}{2}$. Head covered with skin, nearly as broad as long. Snout twice as long as eye, the diameter of which is 6 in the length of head; interorbital width $2\frac{1}{3}$. Jaws equal anteriorly; maxillary barbel extending to middle, or even beyond the end of adipose fin; outer mandibulary barbel about reaching end of pectoral. Occipital process $2\frac{1}{2}$–3 times as long as broad, extending back beneath the skin, separated posteriorly by a distance about equal to its own breadth from the basal shield of the dorsal spine. Dorsal I 6; spine slender; middle branched rays a little more than $\frac{3}{4}$ the length of head; free edge of the fin convex. Adipose fin commencing a short distance behind the dorsal and extending nearly to the caudal, its length $2\frac{1}{2}$–$2\frac{3}{4}$ in that of the fish. Anal 11, low anteriorly, rounded posteriorly, the rays gradually increasing in length to the eighth or ninth, which is $\frac{1}{2}$ the length of head. Caudal forked; lobes of equal length, the upper pointed, the lower rounded. Pectoral spine with inner edge finely serrated, about $\frac{3}{4}$ as long as the fin, which is $\frac{4}{5}$ the length of head. Ventrals extending $\frac{3}{4}$–$\frac{4}{5}$ of the distance from their base to the origin of anal.

Back olive-green or grey; sides blackish blue splashed with whitish; lower parts white; body sometimes covered with dark spots; fins dusky, the dorsal with a light band along the basal part.

"Found all over the island, fairly plentiful, sometimes exceeding a foot in length." Here described from two specimens of 180 and 200 mm. Known only from Trinidad.

14. Pseudauchenipterus guppyi, sp. n. (Plate XXIV.)

"Yellow Catfish."

Depth of body $4\frac{1}{2}$–$4\frac{3}{4}$ in the length, length of head 4–$4\frac{2}{5}$. Snout not longer than eye, the diameter of which is 4–5 in the length of head and 2–3 in the interorbital width. Head nearly as broad as long; upper surface, excepting the snout, rugose, not covered by skin; frontal bones not swollen; profile rising evenly from snout to dorsal fin. Lower jaw scarcely shorter than upper; maxillary barbel extending to anterior $\frac{1}{3}$ or middle of pectoral. Dorsal I 6; spine serrated posteriorly, as long as head. Anal 21; anterior rays longest, in the male thickened and considerably produced. Pectoral spine with serrated inner edge, as long as the head. Ventrals 8-rayed, extending to the origin of anal. Caudal forked. Upper half of body blackish green, with several vertical series of small yellowish-white spots; lower parts white, anteriorly with a dark longitudinal band; fins yellow, the dorsal dark at the base, the caudal with a blackish margin.

Caroni River.

Two specimens, 145 and 185 mm. in total length.

"Caught in numbers, especially where small streams empty themselves into the Caroni."

15. Parauchenipterus paseæ, sp. n. (Plate XXIII.)

"Grouper Cat-fish."

Depth of body $3\frac{1}{3}$ in the length, length of head 4. Snout as long as eye, the diameter of which is $4\frac{1}{2}$ in the length of head and 3 in the interorbital width. Head as broad as long; upper surface rugose, not covered by skin; interfrontal fontanel oval, continued anteriorly as a narrow groove; parieto-occipital a little longer than broad, a little longer than its distance from the base of the dorsal spine; nuchal shield rounded posteriorly, its length equal to that of the basal shield of the dorsal spine (measured in the mid-dorsal line). Lower jaw somewhat projecting; maxillary barbel extending to anterior $\frac{1}{3}$ of pectoral; mental barbel extending a little beyond the base of the post-mental, which reaches the base of the pectoral. Dorsal I 6; spine smooth except for a median anterior series of nodules, a little more than $\frac{3}{4}$ the length of head. Anal 23, rounded anteriorly and posteriorly, slightly emarginate medianly. Pectoral spine serrated on both edges, nearly as long as the head; humeral process extending beyond the middle of the pectoral spine. Ventrals 6-rayed. Caudal obliquely truncate. Yellowish, spotted and marbled with blackish; belly white, with small greyish spots.

Caroni River.

A single specimen, 210 mm. in total length.

"Uncommon, only two specimens taken in a large pool near the Frederick Estate; they were covered with thick slime, which peeled off in sheets soon after they were put in spirit."

16. CALLICHTHYS KNERI Gill.

"Flat-headed Cascadura."

Depth of body 4–4½ in the length, length of head about 4⅔. Head broader than long. Snout broad, rounded, its length 3¼ in the length of head. Diameter of eye 9 in the length of head, interorbital width 1⅖. Parieto-occipital broader than long. Inner barbel longest, extending beyond the middle of the pectoral fin. Coracoids not exposed on lower surface of body. Scutes $\frac{28\text{–}29}{26\text{–}27}$; an irregular series of small scutes in front of the adipose fin. Dorsal 8; first ray a short flat spine, second simple, the rest branched, the middle rays longest, ⅗ the length of head. Anal 6, when laid back extending to base of caudal. Pectoral spine from more than ½ to nearly ⅔ the length of head. Caudal rounded. Brownish or greyish brown, with obscure darker spots; fins yellowish, with dark spots.

Here described from two specimens, 115 mm. in total length, from Trinidad. This fish has not yet been recorded from other localities.

"Plentiful in the Bejucal Swamp, but found all over the island. This fish can shuffle along the ground rapidly and grunts faintly when handled."

17. CALLICHTHYS LITTORALIS Hancock.

"Common Cascadura."

"Very plentiful in muddy swamps and also found in rivers and in ravines with muddy bottoms. In the dry season they are caught and sold in thousands, being much appreciated as food. When the water has subsided in the swamps they are easily captured by baling out the muddy pools. They can move along the ground rapidly and can live a long time out of water; when handled they make a grunting noise. This species constructs a floating nest on the top of the water, and according to Mr. Pasea they breed in the wet season in drains which dry up in the dry season; they are very savage at this period and will make an offensive display when the water is disturbed near their nests."

Hab. South America, from Paraguay to Ecuador.

18. CALLICHTHYS THORACATUS C. & V.

Hab. Brazil; Guiana; Venezuela.

19. CORYDORAS ÆNEUS Gill.

"Small Cascadura."

Depth of body 2½–3 in the length, length of head 3½. Diameter of eye 4½ in the length of head, interorbital width 2. Profile evenly convex from snout to origin of dorsal. Lower lip free, with a pair of barbels which are shorter than the diameter of eye; barbels at the angle of the mouth extending to the base of pectoral fin. Exposed parts of the coracoids widely separated below. Scutes $\frac{22}{20}$, 2 or 3 unpaired ones in front of the spine of the adipose fin. Dorsal I 7; spine $\frac{1}{2}$–$\frac{3}{5}$ the length of head; anterior branched rays longest, $\frac{3}{4}$ the length of head. Anal I 6, when laid back extending to base of caudal. Pectoral spine with serrated inner edge, extending nearly to or a little beyond the base of ventral. Caudal forked. Caudal peduncle much deeper than long. Head and upper part of body dark greenish; lower parts abruptly lighter; fins pale yellow, the dorsal and caudal more or less dusky.

Here described from 5 specimens, 65 mm. in total length, from Trinidad and Grenada. This fish has not yet been recorded from other localities.

20. PLECOSTOMUS GUACARI Lacep.

Hab. Paraguay to Venezuela.

21. PLECOSTOMUS ROBINI C. & V.

Hab. Montevideo; Trinidad.

22. ANCISTRUS TRINITATIS Gthr.

This little-known species may prove to be allied to *A. bachi* Bouleng. Apparently Lütken had a specimen of another species of this genus from Trinidad, which may be related to *A. megacephalus* Günth.

23. XENOCARA CIRRHOSUM C. & V.

"Bearded Teta."

Hab. Paraguay to Venezuela.

24. SYMBRANCHUS MARMORATUS Bl.

"Eel" or "Zangie."

"They live in holes or under rocks or buried in the mud and come out in search of prey, especially after heavy rain. They lie among the dead leaves at the bottom of the pools and grab at the small fry as they pass. During the wet season they may often be seen lying perfectly still at the bottom of the pools.

"Colour: greenish or yellowish, spotted with brownish."

Hab. Tropical America.

25. HAPLOCHILUS HARTI Blgr. (Plate XXI. fig. 2.)

"Small Guabin."

Depth of body $4\frac{1}{2}$–$5\frac{1}{4}$ in the length, length of head $3\frac{3}{4}$–4. Snout a little shorter than eye, the diameter of which is $3\frac{1}{3}$–$3\frac{3}{4}$ in the length of head, interorbital breadth $1\frac{3}{4}$–2. Maxillary not extending to below the eye; jaws equal anteriorly;

bands of small pointed teeth, with an outer series of enlarged teeth; on each side of the lower jaw 1 or 2 teeth of the outer series are stronger than the others, curved, canine-like. 40–42 scales in a longitudinal series. Dorsal 8–9, rounded, the longest rays $\frac{2}{3}$–$\frac{3}{4}$ the length of head. Anal 15–17, commencing at a point equidistant from tip of snout and extremity of caudal, ending below the middle or posterior part of the dorsal fin; rays increasing in length posteriorly. Pectoral about $\frac{3}{4}$ the length of head or of the distance from its base to the base of ventrals. Ventrals 6-rayed, extending nearly to the origin of anal. Caudal rounded or subtruncate, a little shorter than the head; outer rays gradually increasing in length, several terminating at the upper and lower edges and comparatively few at the posterior edge of the fin. Olivaceous or greenish above; sides with bright green or blue longitudinal stripes alternating with series of dark red spots along the rows of scales; vertical fins usually orange; dorsal with 3 or 4 series of small dark spots; anal with 2 or 3 series of very small dark spots on its basal part, often with a narrow dark edge; caudal often with a blackish ocellus on the upper part of its base, sometimes with undulating striæ or series of spots, sometimes with a dark edge.

Here described from 3 specimens, 60–85 mm. in total length, from Trinidad.

Three much smaller specimens from Trinidad and Venezuela were described by Dr. Günther under the name *Rivulus micropus*. The doubt which he expressed as to their identity with the *Fundulus micropus* Steind. of the Rio Negro was well founded, as these specimens show want of agreement with Dr. Steindachner's description in several important respects.

"Found everywhere and the sole occupants of the large pools worn out of the solid rock by the rapid descent of the water in a series of cascades. They are able to reach these mountain pools, which are often situated at considerable elevations, through their powers of leaping. They travel overland during wet weather. Very active and voracious; a female kept in an aquarium swallowed two good-sized 'Belly-fish' (*Girardinus guppyi*), alive and entire, one after the other. They always jump out of any vessel in which they are placed, and if the sides are too high to clear at one leap they can stick on with their fan-like tails and leap higher; when about to leap, or to make an attack, they bend their backs and drop the dorsal fin."

26. GIRARDINUS GUPPYI Gthr. (Plate XXII. fig. 1.)

"Belly-fish."

"This fish receives its name from the fact that the females usually have the abdomen distended with young. It is very plentiful, especially in such places as the 'Dry River,' at Belmont, a suburb of Port-of-Spain, where they swarm in the filthy soapy water that drains from the yards of the dwellings along the river. They save a deal of trouble by consuming the mosquito worms.

The male is a very elegant little fish and varies considerably in colour and marking.

"Colour: Male olivaceous, silvery below; a dark longitudinal stripe from eye to middle of side, another on the posterior part of the body; usually two to four blackish spots, including one at each end of the posterior stripe; these may be accompanied by reddish spots. Female olivaceous, silvery below, without spots or stripes."

27. DORYICHTHYS LINEATUS Kaup.

Hab. Atlantic Coasts and Rivers of Tropical America, the African *D. aculeatus* being apparently distinct.

28. AGONOSTOMUS MONTICOLA Bancroft.

Hab. Fresh-waters of the West Indies (Jamaica, Barbados, St. Vincent, Dominica, Trinidad) and of Mexico.

29. MUGIL BRASILIENSIS Ag.

Hab. Cuba to Patagonia.

30. MUGIL TRICHODON Poey.

Hab. Florida to Brazil.

31. CENTROPOMUS UNDECIMALIS Bl., and

32. CENTROPOMUS ENSIFERUS Poey.

"These fishes, known as 'Broche,' 'Robalo,' or 'Snook,' were caught in the Caroni River, where they have been taken over 20 pounds in weight. They are marine, but go a long way up fresh-water streams in search of food. According to Mr. Pasea, they can be bred in artificial ponds or in large fresh-water pools that have no connection with the sea."

Hab. Atlantic Coasts and Rivers of Tropical America.

33. POLYCENTRUS SCHOMBURGKII Müll. & Trosch. (Plate XXV. fig. 2.)

"The 'King or Black Cascarob' is a very peculiar little fish, which, when alarmed, changes almost instantly from black to whitish or pinkish white, rapidly vibrates the pectoral fins, and, instead of running away, turns on one side and remains for a long time in a crouching position. They are uncommon, and were caught by means of a circular hand-net in the thick rank grass which grows at the sides of the ravines."

Hab. Trinidad; Venezuela; Guiana.

34. CRENICICHLA SAXATILIS L.

"Name 'Mulet' (pronounced Mil-lay). Head olive or greyish green; eye with a dark crimson splash; back dull olive and yellowish green, belly greyish or bluish grey; pale green metallic spots on the sides often present, or if they be absent, blackish cross-bars; sometimes a blackish longitudiral stripe; fins varying from yellowish to blackish blue, sometimes edged with black and white.

"Found singly or in pairs in most streams and pools and take a hook readily at times."

Hab. Rio Grande do Sul to Venezuela.

35. ACARA PULCHRA Gill. (Plate XXV. fig. 1.)

"Small Cascarob."

"This is a very elegant fish, prettily marked with bright green and blue spots and with dark cross-bars on the sides. It was interesting to see one of these beautiful fish in charge of its family of about one hundred young ones, which he or she was vigorously defending. These small fry were moving under its body, and when any other fish made an attempt to snatch one, he or she snapped viciously at the offender. This species is plentiful everywhere."

Hab. Colombia; Venezuela; Trinidad.

36. CICHLOSOMA BIMACULATUM L.

"Large Cascarob."

"Plentiful in muddy rivers, ponds and swamps, but not in the clear streams."

Hab. Brazil; Guiana; Venezuela.

37. PHILYPNUS DORMITATOR Lacep.

"Taken in the Caroni River; the specimen was very docile, allowing us to handle it and making no display of resistance."

Hab. West Indies and Atlantic Coast streams from Mexico to Guiana.

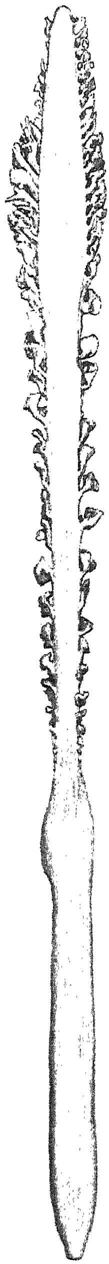
38. DORMITATOR MACULATUS Bl.

"Taken at Bejucal Swamp in muddy pools."

Hab. Atlantic coasts and rivers of Tropical America.

39. GOBIUS FASCIATUS Gill.

Body compressed, elongate, the depth 6 in the length, the length of head $3\frac{1}{2}$–$3\frac{3}{4}$. Snout as long as eye, the diameter of which is 4 in the length of head. Interorbital space narrow. Cleft of mouth slightly oblique, entirely below the level of the eye; maxillary extending to below anterior part of eye; jaws with bands of small pointed teeth and anteriorly with an outer series of larger teeth; posterior tooth of outer series in lower jaw a curved canine. Gill-openings vertical, in front of the bases of the pectorals, not produced forwards below. Head and nape, thorax and lower part of abdomen naked; scales finely ctenoid, increasing in size posteriorly, about 32 in a longitudinal series. Dorsal VI, 12; rays of anterior dorsal, especially the third, produced as filaments in the male. Anal 13. Pectoral without free rays above, as long as head, extending to the origin of anal. Ventrals extending nearly to the origin of anal. Caudal rounded, rather elongate, $\frac{1}{3}$ the length of the fish. Greenish, with dark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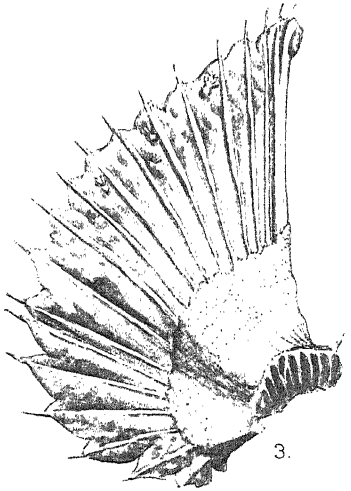
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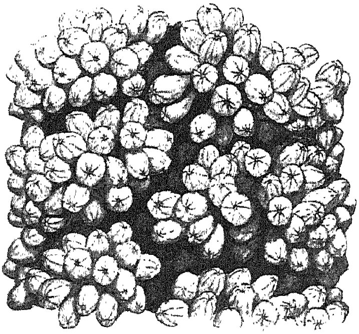
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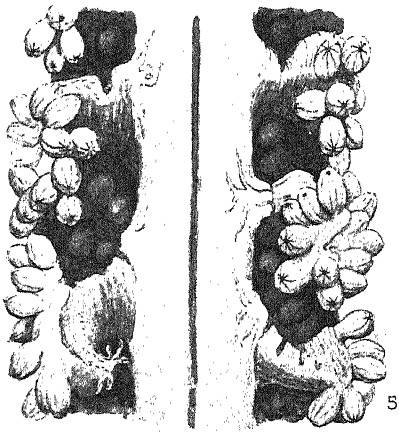
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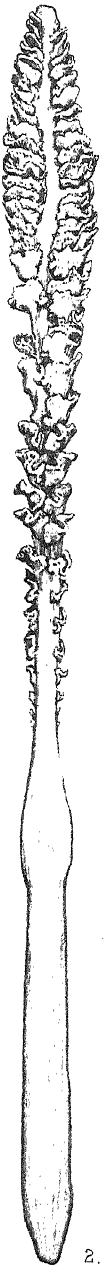
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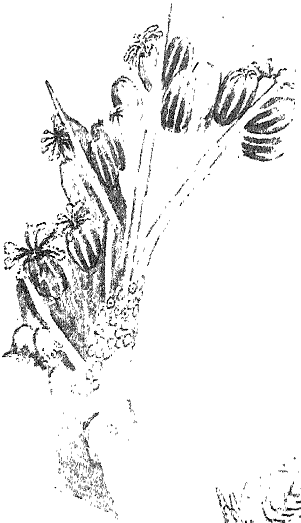

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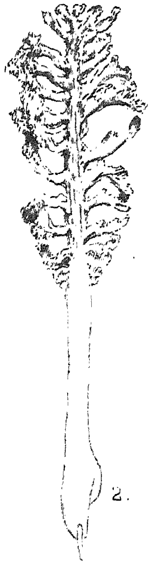

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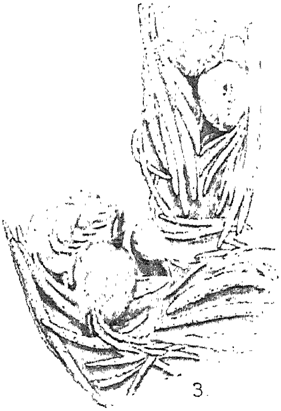

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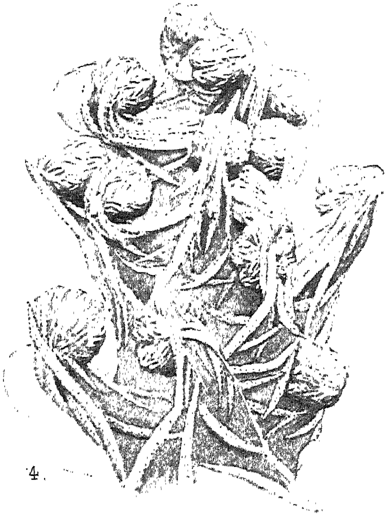

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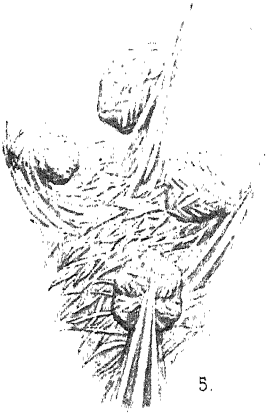

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ALCYONARIANS FROM ZANZIBAR

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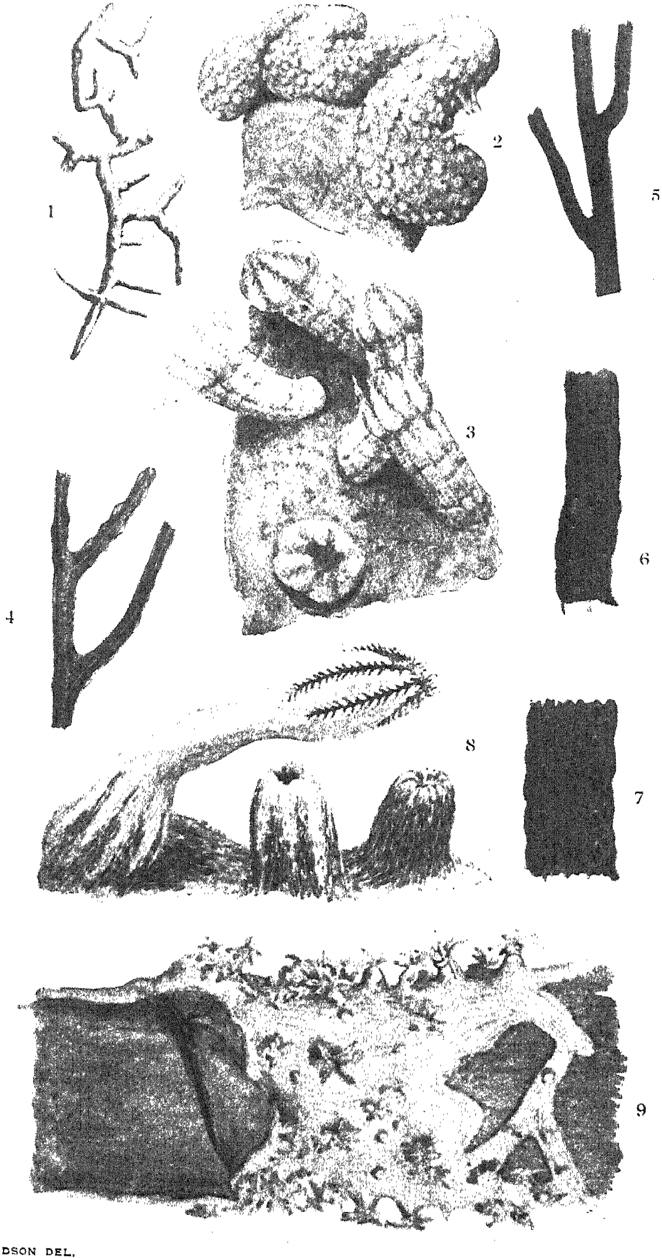

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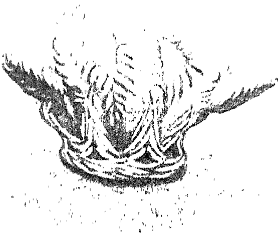

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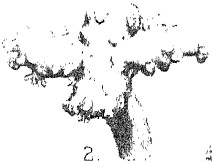

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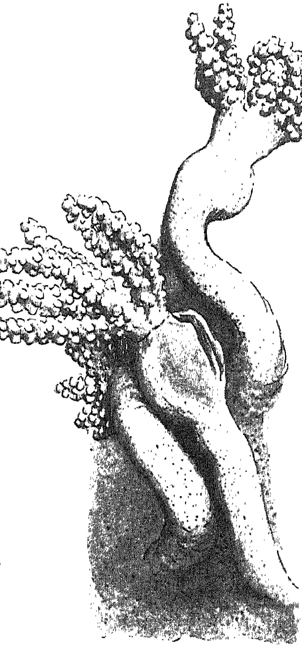

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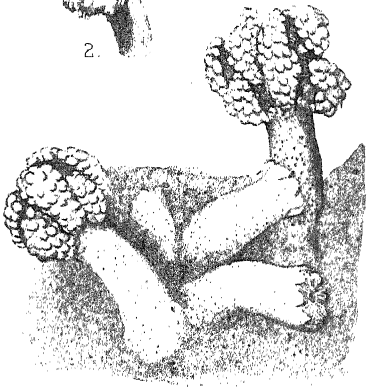

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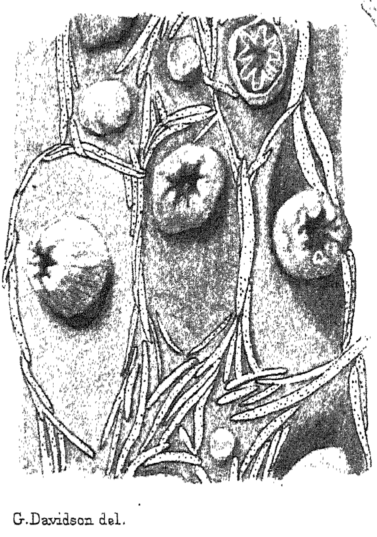

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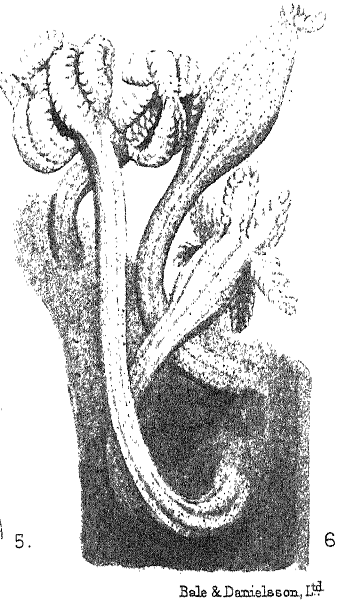

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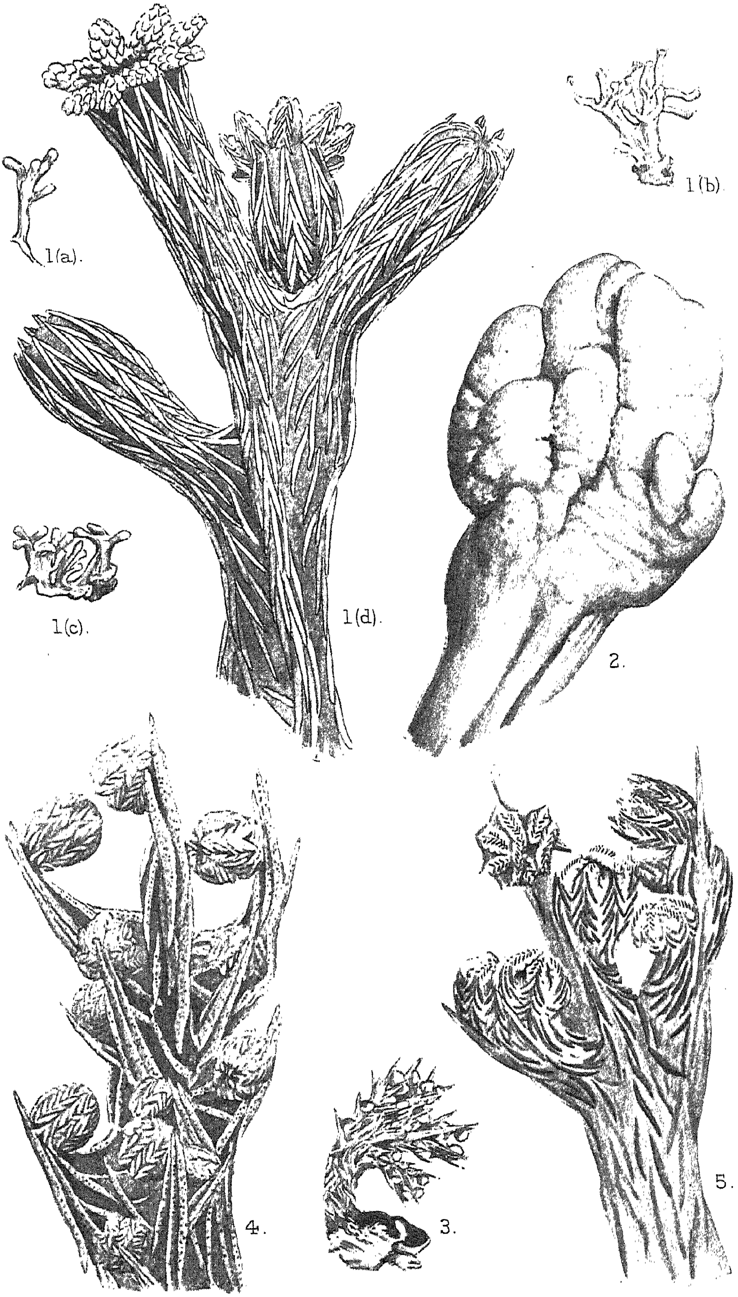

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ALCYONARIANS FROM ZANZIBAR

spots; upper part of head and body with irregular spots; an oblong spot on the lower part of cheek and a triangular spot on the operculum; a series of 3 or 4 linear spots along the middle of the side; a spot at the base of caudal; series of small spots on the dorsal and caudal fins.

Four specimens, 70 mm. in total length, from Trinidad.

I believe this must be the species described by Dr. Gill as *Ctenogobius fasciatus*, although he gives the number of fin-rays as: Dorsal V, 11; Anal 10.

40. Chonophorus banana C. & V.

Hab. Tropical America.

41. Evorthodus breviceps Gill.

Hab. Trinidad; Surinam.

EXPLANATION OF THE PLATES.

Plate XXI.

Fig. 1. *Tetragonopterus guppyi*, p. 384.
2. *Haplochilus harti*, p. 389.
3. *Curimatus argenteus*, p. 385.

Plate XXII.

Fig. 1. *Girardinus guppyi*, ♂. 1*a*. ♀, p. 390.
2. *Chirodon pulcher*, p. 385.
3. *Corynopoma riisii*, ♂. 3*a*. ♀, p. 382.
4. *Tetragonopterus tæniurus*, p. 383.
5. *Tetragonopterus unilineatus*, p. 384.

Plate XXIII.

Parauchenipterus pasceæ, p. 387.

Plate XXIV.

Pseudauchenipterus guppyi, p. 387.

Plate XXV.

Fig. 1. *Acara pulchra*, p. 392.
2. *Polycentrus schomburgkii*, p. 391.

2. The Marine Fauna of Zanzibar and British East Africa, from Collections made by Cyril Crossland, M.A., B.Sc., F.Z.S., in the Years 1901 and 1902.—Alcyonaria. By Prof. J. Arthur Thomson, M.A., University of Aberdeen, and W. D. Henderson, M.A., B.Sc., Carnegie Fellow, University of Aberdeen.

(Plates XXVI.–XXXI.* and Text-figure 85.)

This report deals with the Alcyonarians in the rich collection of marine animals made by Mr. Cyril Crossland at Zanzibar in 1901–2. The Alcyonarians are mostly littoral forms, *e. g.* species

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[*] For explanation of the Plates, see p. 442.

of *Clavularia*, *Sympodium*, *Xenia*, *Spongodes*, *Lithophytum*, and *Sclerophytum*; but there are also some representatives of the deeper water fauna, *e. g.*, species of *Pterocides* and *Virgularia*. A few specimens* collected by Mr. Crossland at Cape Verde Islands have been included in the report. We have been indebted to the indefatigable collector for some notes on the colours of the living animals.

LIST OF SPECIES.

Order I. STOLONIFERA Hickson.
Family CORNULARIIDÆ.
Clavularia garciæ Hickson.
„ „ „ var. *inermis*, nov.
„ *flava* May.
„ *gracilis* May.
„ *reptans* Hickson.
„ *strumosa* Ehrenberg.
„ *margaritiferæ* Thomson & Henderson.
„ *crosslandi*, sp. n.
„ *repens*, sp. n.
„ *pulchra*, sp. n.
„ *zanzibarensis*, sp. n.
„ *mollis*, sp. n.
„ *parvula*, sp. n.
„ *pregnans*, sp. n.
Sympodium punctatum May.
„ *cœruleum* Ehrenberg.
„ *fuscum*, sp. n.
„ *splendens*, sp. n.

Family TUBIPORIDÆ.
Tubipora chamissonis Ehrenberg.

Order II. ALCYONACEA Verrill (*pro parte*).
Family XENIIDÆ.
Xenia umbellata Savigny.
„ *quinqueserta* May.
„ *membranacea* Schenk.
„ *cœrulea* Ehrenberg.
„ *ternatana* Schenk, var. *elongata*, nov.
„ *rigida*, sp. n.
Heteroxenia elisabethæ Kölliker.
Cespitularia cœrulea May.

Family ALCYONIIDÆ.
Alcyonium pachyclados Klunzinger.
Sinularia brassica May.
„ *fungoides*, sp. n.
Sclerophytum polydactylum Dana.
„ *querciforme* Pratt.
„ *marenzelleri* Pratt (=*Lobophytum marenzelleri*).
„ *hirtum* Pratt.
„ *viride*, sp. n.
Lobophytum pauciflorum Ehrenberg.

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* Viz. *Clavularia parvula*, sp. n., *Lophogorgia crista* Möbius, *Leptogorgia ochracea*, sp. n.

Family NEPHTHYIDÆ.
Subfamily SPONGODINÆ.
Nephthya zanzibarensis, sp. n.
" " var. *mollis*, nov.
" *armata*, sp. n.
Spongodes hemprichii Klunzinger.
" *crosslandi*, sp. n.
" *zanzibarensis*, sp. n.
" *kükenthali*, sp. n.
[All these species of *Spongodes* should, according to Kükenthal, be named *Dendronephthya*, but we see no reason to change.]
Stereonephthya zanzibarensis, sp. n.
Lithophytum elegans (Kük.)=*Ammothea elegans* May.
" *viride* (Kük.)=*Ammothea viridis* May.
" *brassicum* (Kük.)=*Ammothea brassica* May.
" *ramosum* (Quoy et Gaimard).
" *thyrsoides* (Kük.)=*Ammothea thyrsoides* Ehrenberg.
" var. *durum*, nov.
" *flavum* May.
Paraspongodes striata Thomson & Henderson.

Subfamily SIPHONOGORGINÆ.
Siphonogorgia intermedia, sp. n.

Order III. PSEUDAXONIA G. von Koch.
Family SCLEROGORGIDÆ.
Suberogorgia köllikeri Wright & Studer, var. *zanzibarensis*, nov.

Family MELITODIDÆ.
Wrightella erythræa Gray=*Mopsea erythræa* Klunzinger.
" *variabilis*, sp. n.

Order IV. AXIFERA G. von Koch.
Family GORGONIDÆ.
Leptogorgia ochracea, sp. n.
Lophogorgia crista Möbius.
" *lütkeni* Wright & Studer.

Order V. STELECHOTOKEA Bourne.
Section A. *ASIPHONACEA*.
Family TELESTIDÆ.
Telesto rupicola Hickson & Hiles.
" *arborea* Wright & Studer.

Family CŒLOGORGIIDÆ.
Cœlogorgia palmosa Wright & Studer.
" *repens*, sp. n.

Section B. *PENNATULACEA*.
Family VIRGULARIIDÆ.
Virgularia mirabilis Lamouroux, var. *pedunculata* Kölliker.
" *multicalycina*, sp. n.

Family PENNATULIDÆ.
Subfamily PTEROEIDINÆ.
Pteroeides brachycaulon Kölliker.
" *rigidum*, sp. n.
" *pulchellum*, sp. n.

GENERAL NOTES.

Before proceeding to the systematic description of species we may call attention to some facts of general interest:—

(1) The collection includes specimens of over 60 species, of which 25 are new. But seven of these new forms belong to the prolific genus *Clavularia*.

(2) The most interesting new forms in the collection are the following:—*Clarularia pregnans* (viviparous), *Siphonogorgia intermedia* (which seems an annectent type), *Wrightella variabilis* (a Melitodid with great variability of coloration), *Calogorgia repens* (with encrusting habit), *Virgularia multicalycina*, *Pteroeides rigidum*, and *Pt. pulchellum*.

(3) Mr. Crossland's Zanzibar collection (63 species) and Prof. Herdman's Ceylon collection (42 species) have only 3 species in common, namely:—

Clavularia margaritiferæ,
Xenia umbellata,
Paraspongodes striata.

Lophogorgia lütkeni, here recorded from the Cape Verde Islands, also occurred in the Ceylon collection.

(4) We have given some illustrations of the great variability of the species of *Clavularia* and *Xenia*, e. g. as to the number of rows of pinnules, the number of pinnules, the bare streak on the tentacles, the spicules, and so on.

(5) VIVIPARITY.—In *Clavularia pregnans*, sp. n., there are large embryos which cause a unilateral protuberance on the polyp-tube a short distance below the mouth. They seem to be liberated by a rupture of the delicate body-wall. Embryos were also found in *Clavularia parvula*, sp. n. Viviparity was recorded by Hickson in *Gorgonia capensis*, and it is probably not infrequent in Alcyonarians, as we have observed it in *Chrysogorgia flexilis* (Th. & H.); *Ceratoisis gracilis* (Th. & H.); *Pennatula indica* (Th. & H.); *Distichoptilum gracile* (Th. & H.); *Umbellula elongata* (Th. & H.), and *Funiculina gracilis* (Th. & H.), all from deep water in the Indian Ocean. Mr. James J. Simpson has also observed embryos in *Isis hippuris*.

NOTE ON LOCALITIES BY MR. CROSSLAND.

As the Alcyonaria are the most abundant and conspicuous part of the littoral fauna of East Africa, and as certain species and genera are characteristic of different localities, topographical information is of especial importance in connection with their description. As collections from East Africa have been described by some investigators who have contented themselves with giving as locality a small village or islet not to be found on any map, and only known to those having special acquaintance with these coasts, I give here some notes on the various localities referred to in this report*.

It must be borne in mind that the Island of ZANZIBAR has a length of 60 miles, and is 20 miles wide at the latitude of the town. It is unfortunate that as the same name refers to both island and town, the locality 'Zanzibar' would include every kind of habitat, while 'Beach near Zanzibar Town' refers to only one, or to two, including the special point towards KIUNGANI which is referred to later.

Zanzibar Harbour is really an open roadstead, partially protected by scattered islets to the north and west and by reefs to the south-west. A considerable amount of my collecting was done on Prison Island, which is one of these, while the name of another, Baui (or Bawe), occurs frequently in the reports of Stuhlmann's collections.

At low spring-tide the shores of Prison Island are over large areas literally bright blue with Xenias of that colour, and this is the case in very many parts of these coasts. Above the level of low spring-tides very little of anything occurs, the rock-flats being nearly bare. This applies to every part of these coasts, but some specimens, referred to in the report, were collected higher up the shore.

The shore at ZANZIBAR TOWN is, at low-tide level, muddy, and Alcyonaria are nearly absent, except at one point towards KIUNGANI, where a copious salt-spring issues from under the slabs of conglomerate which form the upper part of the shore. Here an oasis of wonderful richness occurs in the desert of mud, and corals and alcyonaria cover the whole shore. Brown Xeniidæ and several fleshy Alcyoniidæ are found here in great abundance, some colonies of the latter attaining to the size of a yard across. Dredging just below this level gives good results, but at depths over 3 fathoms or so most of the eastern part of Zanzibar Channel is very barren.

CHUAKA BAY is a large indentation on the East Coast of Zanzibar Island, physically conspicuous, and so coming to be marked on good atlases, but of no commercial utility, producing only a little mangrove timber.

At low spring-tides it presents a great expanse of mud, with channels of water one or two fathoms deep. The lower parts are thickly covered with *Halimeda* sp., and the sides of the channels with grass-like Zostera. A large bank in the centre of the bay is covered with large sponges, looking like stones at a little distance. There is no coral anywhere in this area. Alcyonarians, chiefly Xeniidæ, abound among and upon these weeds, encrusting forms on the bases of the Zostera.

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* For more detailed information, see Proc. Camb. Phil. Soc. xi. p. 493 & xii. p. 35 (1902).

Towards the mouth of the Bay, on the north side, there are three fathoms of water at low tide, and here another marine Phanerogam is abundant, one with a strong hard rhizome and stems, a tuft of opposite leaves arising from the top of each of the latter. On these hard stems great quantities of bright blue encrusting forms were brought up, and among them quantities of brown Nephthyidæ, &c. The quantity and variety of these were most striking, Alcyonarians of one kind or another coming up literally by the sackful at many hauls. This spot was almost the richest in Opisthobranchs and other interesting forms that I ever dredged in.

Kokotoni Harbour is a broad lake-like enclosure between the Island TUMBATU and the north-western shores of Zanzibar. The village, now very insignificant, lies at its south-western corner.

A bank in the narrow southern entrance to the channel upon which corals grow, is a garden of Alcyonarians of wonderful variety and beauty, but on the whole the shores are rather barren even of Xeniidæ. Dredging reveals a current-swept bottom practically barren of all life over the greater part, but in shallower water (5 fath. and under) off the north-west shores an area of great wealth was found, where *Pteroeides* is common.

On the mainland MOMBASA harbour and the reefs in its vicinity are very barren, even Alcyonaria occurring but sparsely and corals being absent. Sir Charles Eliot had seen a good deal of the coast before I arrived and had selected WASIN harbour as the best collecting-ground. This is a canal-like channel separating the island of Wasin from the mainland; the Anglo-German boundary is a few miles south of this. The richness of the shores was found to extend over the whole bottom of the channel. The dredge generally filled with Alcyonaria and sponges in a few minutes, a variety of branched and massive forms occurring in the inner or western parts about the Government station of Shimoni, while towards the open sea great quantities of a *Telesto*, generally more or less overgrown with a red sponge, were brought up time after time, while large colonies of *Lophogorgia* with commensal ophiuroids and cirripedes, the latter embedded in the cœnenchyme, are common.

One expects corals, not Alcyonaria, to be the most conspicuous and abundant form of animal life in tropical seas, but when it is considered that large strips of the East African shores are bare of coral, whereas Alcyonaria occur almost everywhere, and in many places with the profusion one associates with corals, their claim to be of first importance is seen to be well established.

The corals are easily first in the Red Sea, where they abound practically everywhere. Alcyonaria, having the same macroscopic characters as those of East Africa, are present in magnificent abundance, but I have not seen numerous Clavulariidæ, and all the Xeniidæ seemed to be brown or grey, not green or blue.

DESCRIPTION OF SPECIES.

Order I. STOLONIFERA Hickson.

Family CORNULARIIDÆ.

Clavularia garciæ Hickson.
,, *garciæ* Hickson, var. *inermis*, nov.
,, *flava* May.
,, *gracilis* May.
,, *reptans* Hickson.
,, *strumosa* Ehrenberg.
,, *margaritiferæ* Thomson & Henderson.
,, *crosslandi*, sp. n.
,, *repens*, sp. n.
,, *pulchra*, sp. n.
,, *zanzibarensis*, sp. n.
,, *mollis*, sp. n.
,, *parvula*, sp. n.
,, *pregnans*, sp. n.
Sympodium punctatum May.
,, *cæruleum* Ehrenberg.
,, *fuscum*, sp. n.
,, *splendens*, sp. n.

CLAVULARIA.

Note on the Genus.

The problem of species in this genus is very difficult. The differences between species are within a narrow range, and many of the distinctions utilised, *e. g.* number of rows of pinnules, number in each row, seem to be too quantitative in character to be very satisfactory. Moreover, what seem to be well-marked species are connected by intermediate forms, and even in one colony there is sometimes considerable diversity. Let us give some illustrations.

(*a*) To *Clavularia garciæ*, of which Prof. Hickson had one specimen, we are inclined to refer several separate colonies. In some of these the pinnules vary from 13 to 30 on each side, yet the proportions, the general appearance, and the spicules seem identical. Some have one distinct row of pinnules, others have one row with an occasional *simulation* of two rows, others have two *or* three rows. Other specimens agree absolutely with some of these except that we could find no trace of spicules, though some members of the same colony showed a few scattered rods.

(*b*) In specimens which agree well with *C. flava* May, we found the pinnules in one row, in three rows, and in four rows; yet these forms were otherwise alike, showing, for instance, very minute ovoid spicules 0·02 in length by 0·015 in breadth. In another quite similar colony the spicules were rod-like—0·02 in length by 0·005 in breadth—and there were also some discs.

(c) To *C. gracilis* May we have referred a colony with pinnules in three rows as May described, and to the same species we have referred another colony with only one row. This seemed at first unjustifiable till we saw that in the colony with three rows in the majority some polyps only showed two rows, while in the colony with one row in the majority some showed two rows.

(d) The total number of pinnules seems to us of more diagnostic importance than the number of rows, but in what we believe to be *C. garciæ* we find in one colony a range from 16–30 pairs.

(e) Comparisons of different colonies of the same species show that there is little use attaching much importance to the length and breadth of the bare streak on the tentacles unless one is sure that the forms compared are similarly preserved and in similar states of extension.

(*f*) Cases like that which we have for purposes of convenience called *C. garciæ*, var. *inermis*, lead us to agree with Prof. Hickson that the mere absence of spicules does not make a new species.

Our general conclusion is that further investigation will show that a number of species of *Clavularia* should be merged in one, and that at present attention should be paid to the 'tout ensemble' of characters rather than to any single peculiarity when that is of a quantitative nature.

These remarks may serve to support our impression that some of the species of *Clavularia* are in a state of flux, but they may also suggest an inquiry as to the justifiability of adding seven new species to the already lengthy list. The general answer is supplied by the descriptions given; the characters of the new species seem to exclude the possibility of referring them to any of the species known to us from previous memoirs.

It may be useful, however, to indicate briefly some of their outstanding features:—

C. crosslandi has characteristic exceedingly minute spicules like water-worn sand-grains and they are crowded in eight longitudinal white ridges.

C. repens is like the well-defined *C. margaritiferæ*, but has very different spicules—minute capstans and some quadrangular forms with an axial cross.

C. pulchra has unusually long polyps, tentacles, and pinnules.

C. zanzibarensis has 6–8 rows of wart-like pinnules practically covering the short blunt tentacles, and the colour is peculiar.

C. mollis has grouped polyps, thread-like pinnules almost covering the tentacles, and an unusual amount of contraction.

C. parvula has very unusual tentacles with only 9 pinnules on each side, though certainly mature, as the eggs and embryos show.

C. pregnans has short conical pinnules all round the tentacles and a very large genital expansion with embryos.

We may also call special attention to the viviparity readily demonstrable in *C. pregnans* and also apparent in *C. parvula*.

Very noteworthy in some of the species is the profuse abundance of zoochlorellæ.

The beginning of a differentation of calyx and anthocodia in *C. margaritiferæ* may be regarded as a hint of the *Sympodium* type; the slight union of the bases of the polyps in *C. mollis* may perhaps be regarded as pointing towards the *Xenia* type.

CLAVULARIA GARCIÆ Hickson.

Several specimens appear to be referable to this species, if its diagnosis is made rather more elastic.

The polyps are 10–13 mm. in length, with thin transparent walls, and show no sign of being able to contract. Mr. Crossland states that the living forms had very mobile tentacles opening and closing regularly.

The tentacles are from 6–8 mm. in length and have the pinnules arranged so as to leave a wide bare space on the oral and a narrower bare space on the aboral surface. The long pinnules are in one row and they vary in number from 16 to 30 on each side. There is occasional simulation of two rows.

The fact that the pinnules vary from 16–30 pairs shows that the number of pinnules is not in itself a character of much diagnostic importance.

Minute, slightly roughened, rod-shaped spicules are abundant throughout the colony and give it a peculiar glistening appearance; they are from 0·04–0·05 mm. in length and 0·007 mm. in breadth. Hickson describes the spicules of *C. garciæ* as scattered and not crowded; they are here densely crowded.

Locality. Chuaka, E. Zanzibar. Previously from Chagos Archipelago.

In another group of polyps, which we are inclined to refer to the same species, there are some interesting differences. The bodies of the polyps are more substantial, but they are more contracted (5·4 mm. in length). The tentacles are about 4 mm. in length, and while some show two rows of pinnules with perfect clearness, others show three rows equally distinct. The number of pinnules in a row varies from 12–15.

In the body of the polyp and on the tentacles the spicules are closely packed, thus giving a granular glistening appearance to the polyp. The spicules are 0·05 mm. in length, and seem to be *identical* with those above described.

Locality. Wasin, British East Africa.

CLAVULARIA GARCIÆ Hickson, var. INERMIS, nov.

The polyps, which rise from a membranous stolon to a height of 9 mm., are marked by annulations and also by longitudinal lines. The tentacles are long and pointed, from 3–3·5 mm. in length by 0·8 mm. in breadth at their proximal end. The pinnules are arranged in three rows on each side, in the outer row they may vary from 19–23 in number. They leave a free space on both the oral and the aboral surface. In some polyps we found no trace of spicules; in others we found a few small rods. There are crowded zoochlorellæ.

CLAVULARIA FLAVA May (*non* Hickson). (Plate XXX. fig. 4.)

Four small pieces of a light brown colour appear to be referable to this species. The basal membrane is soft and about 1 mm. in thickness, and bears crowded polyps. The polyps are substantial, marked by annulations and also by longitudinal furrows, 3–4 mm. in length by 0·75–1 mm. in breadth, with *lanceolate* tentacles fully 3 mm. in length, with acute ends.

The pinnules are very short and blunt, arranged in four rows on each side, usually 17 in a row.

The spicules are densely crowded, extremely minute, smooth oval discs, about 0·02 mm. in length and 0·015 mm. in breadth. Prof. Hickson speaks of the spicules of *C. garciæ* as the smallest he had seen, but these are much smaller.

Locality. Zanzibar shore, low tide among coral.

Previously recorded from Zanzibar.

In another clump, growing on a monocotyledonous twig, the polyps are usually 9 mm. in length by 1–1·5 mm. in breadth and are longitudinally ridged. The tentacles are 3–3·2 mm. in length by 0·8 mm. in breadth, with the pinnules arranged in three rows on either side of the middle line. The pinnules, many of which are slightly clavate at the tip, leave a long bare space on the aboral surface which extends the whole length of the tentacle and tapers slightly, but on the oral surface the bare space is very wide at the base, narrows quickly, and becomes almost linear for the greater part of the length of the tentacle. The pinnules are from 0·18–0·25 mm. in length by 0·13 mm. in breadth. Abundant ova were present in the lower part of the polyps. The spicules are small rod-like bodies 0·02 mm. in length and 0·005 mm. in breadth, and there were also some discs.

In another colony spreading on *Millepora* some of the polyps showed only one row of pinnules on each side, while contracted forms showed three. The spicules were very minute, smooth, ovoid discs, 0·02 by 0·018 mm.

CLAVULARIA GRACILIS May.

A small colony agrees with this species in having:

(*a*) polyps of very diverse lengths, up to 20 mm.;
(*b*) short and thick pinnules in three irregular rows (sometimes apparently in two rows);
(*c*) no calcareous bodies;
(*d*) tentacles about 5 mm. in length.

There is no funnel-like expansion * at the top of the polyp as was frequently observed by May; the bare streak on each side of the tentacles is broad rather than narrow; there are 20–30 pinnules in each row.

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* From what we have seen in *C. pregnans*, sp. n., we are inclined to suggest that these expansions, noted by various authors in different species, may be reproductive enlargements.

Locality. Chuaka, Zanzibar.

Previously recorded from Mozambique, Tumbatu.

To the same species we refer another colony with a thin basal membrane, polyps about 12 mm. in length, tentacles 2–5 mm., and no calcareous corpuscles.

In most of the polyps examined there is most distinctly only one row of pinnules, whereas in *C. gracilis* May there are three irregular rows. We have disregarded this difference because some of the polyps on our specimen showed two rows. As before indicated, this does not seem a specific character of much importance.

Locality. Chuaka.

Clavularia reptans Hickson.

A colony spreading over a monocotyledonous leaf seems referable to the *Clavularia reptans* of Hickson. The narrow stolon is from 0·5–1 mm. in breadth and forms a network.

The polyps are distant, separated by an interval of 4 mm. A common length is 3 mm., the breadth is 1–1·5 mm.

As Prof. Hickson points out, this species is noteworthy in having the contracted polyps decidedly broader than the stolon which bears them. This is also true of *C. margaritiferæ* Thomson & Henderson.

The short tentacles are about 1 mm. in length and bear 12–15 pinnules on each side, each pinnule 0·1–0·15 mm. in length. There are no spicules.

Locality. Zanzibar shore. Previously from Celebes.

Clavularia strumosa Ehrenberg.

The collection included numerous representatives of this species growing on twigs. They appear to be very variable.

The polyps are firm and marked with annulations and longitudinal lines; they are often inflated just below the tentacles or just above the stolon. They vary in length from 4–12 mm. and in breadth from 1–1·2 mm.

The pinnules are short and blunt, arranged in three rows on each side of the middle line, leaving a considerable bare streak on the aboral surface and a fairly wide bare streak on the oral surface of the short but pointed tentacles. The number of pinnules in a row varies from 11–14, but 12 is the usual number.

There are numerous calcareous bodies—oval or roundish discs, length by breadth 0·02 × 0·016–0·018 mm. By transmitted light they appear yellowish to yellowish brown in colour, but by reflected light they appear bluish to bluish green. When the edge is presented to view they appear as oval blunt rods.

The colony comes near *C. strumosa*, but the calcareous bodies are somewhat different, and no rods are present unless the side view of the discs could be called rods.

In another set of specimens very like those mentioned above the polyps vary from 3·6–5 mm. in length. They are marked by annulations and sometimes by longitudinal lines. The tentacles are short, but the pinnules are arranged in three rows. The spicules are small discs 0·01 mm. in diameter, somewhat pitted in appearance.

Locality. Zanzibar shore. Previously from Zanzibar, Red Sea.

CLAVULARIA MARGARITIFERÆ Thomson & Henderson.

Numerous stiff white polyps rise at right angles to a height of 6–7 mm. from narrow stolons (0·3–0·4 mm. across) spreading over a flattened twig. The strands of the stolon may form a network, but never coalesce into a membrane. The specimens agree closely with *C. margaritiferæ*, e. g. in the abundance of interlocked capstan-like spicules (double clubs and double wheels), 0·04–0·07 by 0·02–0·04, with three or four large tubercles at each end, in being broader orally than basally (0·6 at the base, 1–1·3 mm. distally), in being often broader than the stolon. A small portion of the upper end of the polyp is capable of invagination along with the tentacles; the expanded tentacles are seen in a few forms as if rising on a narrower neck from within a broader funnel. There is thus the beginning of an interesting distinction between a calycine portion and an anthocodial portion which are separated by a slight constriction. This points on to *Sympodium*. There is a single row of 8 or 9 short pinnules on each side of the tentacles; they are about 0·1 mm. in length.

The specimen differs from that described as *C. margaritiferæ* in having no spicules on the tentacles. The rest of the surface has a granular appearance due to the spicules.

Locality. Chuaka.

Previously recorded from Gulf of Manaar.

CLAVULARIA CROSSLANDI, sp. n. (Plate XXX. fig. 6.)

The stolon is a membranous plate. The general colour is light brown.

The polyps are long and slender, the walls deeply marked by longitudinal narrow grooves and broad white ridges. The length of the polyps is about 5 mm., the breadth about 0·75. The tentacles are 2·5–3 mm. in length. Many of the polyps have a swelling just below the insertion of the tentacles, 1·2 mm. in width.

The tentacles are flat and lanceolate, with the pinnules arranged in two rows, but this appearance may be due to the crowding of the pinnules of one row. They leave a bare space on the oral as well as on the aboral surface of the tentacles. The pinnules are very short and bluntly conical, thereby differing very markedly from *C. garciæ*, which the colour and the longitudinal grooves at first suggested. There are several noteworthy features in regard to the spicules:—(*a*) they occur in crowds on the ridges and give these their white colour, and are also continued up the backs of the tentacles; (*b*) they are irregular ovals like water-worn sand-grains; and (*c*) they are exceedingly minute, 0·01–0·02 in length by 0·005–0·01 in breadth.

Locality. Zanzibar Channel, low water.

CLAVULARIA REPENS, sp. n.

This colony was found growing along with Hydroids on submerged stems of the marine phanerogram before mentioned. Its colour when living was reddish with brown polyps. The stolon consists of narrow strands.

The polyps are from 4·5–5 mm. in length, with an oral diameter of 0·9–1 mm. They are narrower at the base.

The tentacles are very short, only 0·4 mm. in length, with short pinnules arranged in one row on each side of the middle line. Each row consists of about 8 pinnules, and the two rows leave a very wide bare space on the aboral and a slightly narrower space on the oral surface of the tentacle.

The specimen bears a strong superficial resemblance to *C. margaritifera* Thomson & Henderson, but the spicules are entirely different. Here they consist of a continuous sheet of minute capstans (about 0·03–0·05 mm. in height and about 0·02 in breadth). There are also some quadrangular forms with an axial cross (0·05 × 0·05).

Locality. Common in Chuaka Bay.

CLAVULARIA PULCHRA, sp. n.

A membranous plate gives origin to numerous long polyps (23·5 × 3 mm.) with thin transparent walls. The tentacles, 9 mm. in length, are transparent and feathery, with the pinnules arranged in three rows on each side of the middle line, leaving a bare strip on the oral and also on the aboral surface The pinnules are long, cylindrical, and incurved, about 1·5 mm. in length, usually 30 in a row. There are a few minute rod-like spicules 0·05 mm. in length and 0·007 mm. in breadth. The colour in spirit is white.

In some respects this species approaches *C. celebensis* Hickson, *e. g.* in the large number of the pinnules, and in the long polyps and tentacles. It differs in having a membranous stolon (as in May's specimen), crowded polyps, thin polyp-walls (*cf.* May, p. 44), much more substantial pinnules, and distinct spicules.

In another specimen it is worthy of note that the pinnules are found in all stages of retraction, from 2 mm. in length to small wart-like projections.

Locality. Zanzibar shore.

CLAVULARIA ZANZIBARENSIS, sp. n.

A dense crowd of short polyps arises from an irregular membrane spreading on nullipores. We have been unable to refer it to any of the known species. The average length of the contracted polyp is 5 mm.

The tentacles are short and blunt, 1·8 mm. in length and 0·7 mm. in breadth. The pinnules practically cover the whole surface; they are very small and wart-like, and are arranged in 6–8 rows. No calcareous bodies are to be seen, but there are abundant zoochlorellæ with a diameter of 0·01 mm. Many of the polyps show abundant ova. The colour in life was described as "pinkish brown with blue tentacles."

It may be unsatisfactory to establish a new species for specimens which have so few positive characteristics; it seems to us the most workable way of finally arriving at a knowledge of the relationships within this prolific genus. It must be left to some one working on the spot to reduce the number of species by discovering the annectent forms.

Locality. Near Kiungani, Zanzibar.

CLAVULARIA MOLLIS, sp. n.

The polyps of this rather puzzling form arise from a thin semi-transparent membranous plate, 36 mm. long and 21 mm. in maximum width; they seem to be crowded on the surface, but when separated considerable spaces are seen between their bases. They are arranged in small groups of 4–8, which are joined together for a short distance from their base by the fusion of their walls. But each polyp can be traced to its origin, and does not lose itself in a stalk-like portion as in *Xenia*. Scattered between the groups small single polyps may be seen. The polyps are capable of considerable contraction, as some appear like small teat-shaped papillæ on the surface of the basal membrane. The oral opening of the polyps is small and pore-like, situated on the summit of a teat-like papilla. The tentacles are short, with slender pinnules arranged all round. The stomodæum is short, measuring only 0·9 mm. in length by 0·2 mm. in breadth in an adult polyp.

There are numerous ova in most of the polyps.

This species is also represented by a badly-preserved colony 40 mm. in length and 25 mm. in breadth. The stolon is smooth, flat, and membranous. The polyps are 3 mm. in length, nearly 1·5 mm. in diameter, and are much contracted with numerous annulations. The tentacles are nearly as long as the polyps (2·7 mm.). The slender pinnules almost cover the tentacles, but there is a bare aboral streak; a common length is 0·5 mm.; there are 6 rows of about 15 in each row. In the basal portions of the polyps abundant ova are present.

This form approaches in some ways May's *C. flava* (*non* Hickson's *C. flava*), but the pinnules are thread-like instead of being blunt, and there is no trace of spicules.

Locality. Zanzibar shore.

CLAVULARIA PARVULA, sp. n.

A colony spreading upon a stone, the individuals united partly by narrow stolons but mainly by a coherent membrane. The polyps may attain a length of 5 mm., not including the tentacles, which are usually about 3 mm. long. The breadth of a fully-extended polyp is slightly under a millimetre. Some of the polyps have their tentacles wholly retracted, and are themselves contracted into sugar-loaf-like prominences about 3 mm. in height. There is no evidence of calcareous bodies either in tentacles or polyps, and the colour of the preserved specimen is translucent white.

The most characteristic features are presented by the tentacles. They measure almost half a millimetre at the base, but narrow somewhat quickly and end in a fine point. They appear to be slightly convex aborally and slightly concave orally. When fully expanded they form a circle about 3·25 mm. in diameter. The pinnules are about nine in number on each side, but the four nearest the base of the tentacle are very short, the longest pinnules being usually numbers 4 and 5 from the distal end; they are separated from one another by short intervals; and towards the base, beginning at the sixth, there is a gradual shunting from a lateral position on to the oral surface of the tentacle. In shape the pinnules are cylindrical, and have a somewhat rugose appearance due to contraction.

In another specimen, which had a red colour when living, some of the polyps attain a length of 10 mm., not including the tentacles, and are densely packed with eggs and embryos. In the majority the tentacles and the œsophageal region are completely retracted within the smooth-walled calyx. In some parts of the colony the polyps are connected by narrow stolons about 1 mm. in diameter; in others there is a continuous membrane.

Locality. Cape Verde Islands.

CLAVULARIA PREGNANS, sp. n. (Plate XXX. fig. 3.)

This interesting form is well marked by two peculiarities. In the first place, the pinnules occur all round the tentacles. This unusual arrangement is also seen in *C. inflata* Schenk, but, apart from the generic characters, there is little else in common between the two species. The second peculiarity is that many of the polyps show a large expansion of the body, containing a large embryo or as many as three.

There is a thin basal membrane growing over a polyzoon. The polyps, sometimes marked by contraction-rings, are about 5 mm. in length and 1 mm. in breadth, with slender tentacles of 2·5–3 mm. in length by 0·35–0·4 in breadth. No bare streak is to be seen on the tentacles, which are surrounded by short conical pinnules with a kind of spiral arrangement. Crowded zoochlorellæ produce here and there a glistening appearance, but no trace of spicules could be seen.

Many of the polyps show at a short distance below the tentacles a prominent expansion (2·5 mm. in diameter) of the tube containing up to three embryos. As these grow one side of the expansion becomes thin-walled and is readily ruptured. The embryos appear as elongated lemon-shaped bodies, 1 mm. in length by 0·75 in maximum diameter. There are numerous ova on the mesenteric bands. It may be suggested that the expansions figured by May in *C. longissima* and *C. strumosa* are also reproductive swellings.

Locality. Wasin Channel, 10 fathoms.

SYMPODIUM PUNCTATUM May. (Plate XXIX. fig. 9.)

A specimen spreading over a monocotyledonous leaf agrees on the whole with the description which May gives of *S. punctatum*. There are two sets of spicules—the upper layer whitish, the lower layer deep red. The spicules are about 0·2–0·3 mm. in length; they are fundamentally of the spindle-type, but bear irregular warty processes, often with sharply truncate ends. The white spicules lie irregularly in an almost continuous superficial covering; the deeper red spicules are partly interlocked by their warty, often branched projections. The colour scheme is slightly different from that of May's specimen, since the red spicules are almost entirely confined to the basal membrane.

Locality. Chuaka shore, low spring-tide. Previously from Tumbatu.

SYMPODIUM CŒRULEUM Ehrenberg.

To this species we refer several rather poor specimens "of a sea-green colour," with polyps which can be completely retracted. The basal membrane is a broad plate, 33 mm. in maximum length and 16 mm. in maximum width. It is thin at the edges, but 1 mm. in thickness near the middle.

The polyps have short tentacles on which the finger-shaped pinnules are arranged in one row on each side, about 15 in each row.

There is no trace of the calcareous bodies which Klunzinger figures; there are abundant zoochlorellæ. The cœnenchyma of the colony is hyaline and non-granular.

Locality. Previously from Tumbatu, Red Sea.

SYMPODIUM FUSCUM, sp. n. (Plate XXX. fig. 5.)

A spreading colony, forming large flexible sheets attached to basal parts of Zostera. The living specimens were reddish brown all over, except the tentacles which were drab-brown; the preserved specimens are creamy-white.

The stolon is a membranous plate from 2–3 mm. in thickness, rather thinner at the edges. The polyps are uniformly distributed over the surface, and are capable of complete retraction into the stolon, thus giving it a porous appearance, somewhat honeycomb-like. The pores have a diameter of 1 mm., and are about 0·5 mm. apart. Spicules are numerous in the stolon, and form a superficial network, in the meshes of which the polyps stand. Between the larger meshes there are smaller ones on which young polyps are seen.

The polyps are about 5 mm. in length, with tentacles of 1·5 mm., with about 8 short pinnules in a single row on each side. On the lower part of the polyp body there are no spicules, but just below the base of the tentacles spicules become abundant, at first arranged transversely, then in more or less regular converging double rows running perpendicularly. There are also a few small irregularly-disposed spicules in the tentacles.

This species closely approaches *Sympodium* (*Alcyonium*) *fulvum* Forsk., but differs in that the upper part of the polyp has no transverse ring of spicules markedly different in size from the longitudinally-disposed spicules, in the presence of spicules on the tentacles, and in other features.

Localities. Wasin, Chuaka, Kiungani. Common.

SYMPODIUM SPLENDENS, sp. n. (Plate XXIX. fig. 8.)

A beautiful purplish-crimson colony, spreading around a monaxonid sponge. The sponge has a tubular form (probably due to some foreign axis which has been lost). The basal membrane is about 2 mm. in thickness; the polyps occur irregularly, sometimes almost touching, elsewhere separated by intervals of 4 mm. or so. A fully-extended polyp is 3–3·5 mm. in length; the tentacles extend for 2–2·3 mm. further; the average breadth of a polyp is 1·75 mm.

When the polyp is completely retracted we see a blunt conical calyx (often 2·5 mm. in height), with 8 longitudinal ridges not very sharply defined, and ending in 8 triangles. The whole is purplish crimson, except at the summit, where a hint of the yellowish-white polyp is seen. The fully-expanded polyp is almost transparent, for the coloured spicules are not continued beyond the calyx. The flat tentacles have a broad bare streak on each surface; there are two rows of pinnules on each side, 20–24 in each row. There is great variety in the spicules:—(*a*) Straight and curved spindles with prominent warts, usually few and distant, sometimes fairly numerous (0·4 × 0·04, 0·35 × 0·03). (*b*) Irregular forms: triradiate (0·175 × 0·15), quadradiate (0·2 × 0·125). The great majority are purplish; others are transparent, with a considerable organic residue, a few incline to red.

Locality. Chuaka.

Family TUBIPORIDÆ.

TUBIPORA CHAMISSONIS Ehrenberg. (= *Tubipora musica* Chamisso.)

Locality. Large colonies are abundant wherever coral grows: *e. g.*, Prison Island and the reefs south of Zanzibar Harbour, edge of eastern reef of Pemba. Not found at Chuaka, rare at Wasin.

Order II. ALCYONACEA, Verrill (*pro parte*).

Family XENIIDÆ.

Xenia umbellata Savigny.
,, *quinqueserta* May.
,, *membranacea* Schenk.
,, *cærulea* Ehrenberg.
,, *ternatana* Schenk, var. *elongata*, nov.
,, *rigida*, sp. n.
Heteroxenia elisabethæ Kölliker.
Cespitularia cærulea May.

Note on the Species of Xenia.

In the genus *Xenia*, as in the genus *Clavularia*, the question of species is a difficult one. All the species are within a relatively narrow range, and the differentiating characters are, when taken separately, somewhat trivial. Even in the same colony there are sometimes noteworthy differences in the adjacent polyps—differences which are sometimes as marked as *any one* of the separate items which are used to distinguish species. It seems likely that many of the differences are purely *modificational*, and referable to differences in nutrition and the like.

The number of rows of pinnules is a character which has been much relied upon, but it is apt to lead one astray unless the tentacles observed are equally extended. Moreover, there may be 3 rows at the proximal end and 4 about halfway up, or 2 at the proximal end and 3 about halfway up the tentacle. There can be no confusion between a species with *one* row of pinnules on each side and a species with *four* rows on each side, but to distinguish two species because one has three rows and the other four appears to us quite misleading unless this detail is supplemented by many others. In *X. umbellata* we found from 2–4 rows, in *X. quinqueserta* 3–5 rows.

Some workers have attached importance to the presence of wart-like pinnules along with others of the usual elongated type; but the presence of a few wart-like pinnules at the proximal end appears to us to be very common, and may be naturally expected when a polyp is not fully grown. At the same time, the minute warts of, for instance, *X. rigida* are diagnostic in contrast to the long pinnules of *X. umbellata*.

Another diagnostic feature is the presence or absence of a bare strip on the surface or surfaces of the tentacle, but this is apt to be obscured or exaggerated by the degree of contraction. The bare streak may be present at the proximal end and absent higher up, or quite distinct along the distal half and quite obscured by contraction lower down.

XENIA UMBELLATA Savigny.

The length of the stalk is 24·5 mm., with a maximum basal diameter of 11 mm.; the polyps are 9–15 mm. in length, 1·2–2 mm. in breadth, with tentacles 6·5–8 mm. in length and 1·5 mm. in breadth. A few young polyps are present among the older polyps, and have an average length of 1·9 mm. and an average width of 0·5 mm. On their small tentacles, however, from 6–7 pairs of pinnules may be seen.

The tentacles in the older polyps are long and slender, with the middle line free throughout its entire length on the aboral surface. The long and slender pinnules are arranged in 2–3 rows on either side of the middle line. Between 30 and 40 were counted on one row. There are abundant calcareous corpuscles of minute size. Numerous zoochlorellæ are also present throughout.

X. umbellata appears to be a very variable species if we extend it to include those forms with not more than 3 rows of very long and numerous pinnules, with tongue-like flattened free axis.

In another specimen the polyps were from 5–11 mm. in length by 1·5 mm. in breadth, with thin transparent walls, with spherical calcareous bodies. The tentacles are long in comparison to the length of the polyp, for they vary from 6·5–7 mm. in a polyp which measures 11 mm., and they may be even longer than the polyps.

The long and slender pinnules (1·4 mm. long by 0·15 mm. wide) are arranged in *two or three* rows on either side of the middle line, leaving on both surfaces a free space which runs the whole length of the tentacle, and giving a fine feather-like appearance to the tentacle.

In the younger polyps, which measure about 3·3 mm. in height, the tentacles reach a length of 2·3 mm., and have the pinnules arranged in 3 rows, in the outermost of which there are from 7–9 pinnules. There are numerous spherical zoochlorellæ.

Another set of specimens (from Chuaka, E. Zanzibar) were characterised by the very long polyps (12–25 mm.), the flatness of the tentacles, and the delicate triangular pinnules in five rows proximally and three rows distally with 24–26 in each row.

Another specimen, which when living was white with yellow-brown tentacles, was found growing over nullipore branches. The stalk is firm and has an average length of 11 mm., and an average breadth at the upper end of 4 mm. The polyps are thin-walled and transparent, thickly placed on the crown, from 5–6 mm. in length, with an average width of 0·8 mm. The tentacles are very feathery in appearance, and vary in length from 2–3·2 mm., and have a maximum diameter of 1 mm.

The pinnules are arranged in *four* rows on each side of the middle line, leaving a free space on both the oral and the aboral surface. In the outer row of pinnules the number varies from 14–18, but 17 is the commonest number.

There are very numerous zoochlorellæ with a diameter of about 0·01 mm., and there are also calcareous corpuscles.

Locality. Wasin Channel, 10 fathoms; previously recorded from New Britain and from the Red Sea.

XENIA QUINQUESERTA May.

To this species, though its validity seems to us doubtful, we refer a colony with a smooth cylindrical stalk 15 mm. long by 4 mm. in diameter. The polyps are crowded in a kind of capitulum, and are, apart from the tentacles, 11 mm. long. The tentacles are 3·5 mm. in length and bear 3–5 rows of short conical pinnules on each side of the well-marked bare streak. There are about 20 pinnules in each row. No calcareous bodies were seen, but there are abundant zoochlorellæ.

It does not seem to us that *X. quinqueserta* May is well defined off from *X. sansibariana* May, and we suspect that both may be varieties of *X. umbellata* Savigny.

Locality. Chuaka. Previously from Tumbatu.

XENIA MEMBRANACEA Schenk.

To this species we refer several small specimens found spreading over the branches of an alga. They agree in having 3–4 rows of pinnules which cover the oral surface of the tentacles except a small triangular space at the base, and leave a bare strip up the aboral surface. There are 15–20 slender conical pinnules in each row. The bodies of the polyps are about 5 mm. in length, with an average width of 0·75; the tentacles are 4–5 mm. in length. There are small polyps at the bases of the full-grown individuals.

Locality. Shore, Zanzibar. Previously recorded from Ternate (*Schenk*) and New Britain (*Ashworth*).

XENIA CŒRULEA Ehrenberg.

To this species we refer a small specimen with two rows of uniform pinnules on each side of the middle line of the tentacle. There is a free streak on both surfaces. The pinnules are slender, cylindrical, and truncate. The body of the polyp was 4 mm. in length, the tentacles were about the same.

Another specimen is distinguished by the thickness of the polyps (2·5 mm. to a length of 9), by the long truncate pinnules, numbering about 24 in each row. In both specimens the colour in spirit was white.

Locality. Shore, Zanzibar. Previously recorded from Red Sea (*Klunzinger*) and Indian Ocean (*Bourne*).

XENIA TERNATANA Schenk, var. ELONGATA, nov.

To this species we refer a specimen with long slender polyps, long flat tentacles, and two rows of pinnules on each side. The pinnules are reduced to warts near the base, but soon become short cones. There are about two dozen in each row.

It differs from Schenk's description, (*a*) in the great length of the polyps (10–19 mm.); and (*b*) in having no supporting trunk, but only a membranous stolon spreading among seaweed. If emphasis is laid on the nature of the pinnules and the number of rows, the specimen may be fairly placed beside *X. ternatana*.

Locality. Chuaka.

XENIA RIGIDA, sp. n.

A small colony 15 mm. in height by 12 in breadth, and 8 in thickness.

The polyps are stiff and substantial, about 3·5 mm. in height, with a basal breadth of 3 mm., tapering to 1·75 at the base of the tentacles.

The tentacles are 2 mm. long and bear three rows of rounded wart-like pinnules, leaving a triangular bare streak on both surfaces. There are about a dozen pinnules in each longitudinal row. The pinnules appear very closely packed in sloping transverse rows of three. The whole surface of polyps and tentacles is thickly covered by minute rod-like spicules (0·06 × 0·08), which produce a somewhat glistening frosted appearance. Besides these there are numerous zoochlorellæ.

This form resembles *X. plicata* Schenk in having rounded wart-like pinnules in three rows, but differs in the shape of the tentacles, the number of the pinnules, and the nature of the spicules (round or oval discs in *X. plicata*).

Locality. Wasin Channel, 10 fms.

HETEROXENIA ELISABETHÆ Kölliker.

A dense cluster of dimorphic polyps borne on a thick stalk about 2·5 centims. in height, and 1 centim. in breadth. The cluster itself has a diameter of 3·5 centims. The living forms were white and grey in colour, and kept the tentacles continually and rapidly opening and closing.

The large polyps are numerous and marked by annulations which are probably due to contraction. They vary from 15–22 mm. in length, and from 2–2·5 mm. in breadth. The tentacles in the fully matured polyps are from 5·5–6·5 mm. in length, and 0·5 mm. in width.

The pinnules are arranged in four rows on each side of the middle line, leaving both on the oral and on the aboral surface a bare strip which stretches the whole length of the tentacle. The pinnules are 0·6–0·9 mm. in length, and from 0·05–0·2 mm. in width. They are all long and slender, with the exception of a few wart-like pinnules at the proximal end.

Besides the relatively distant large polyps, the crown bears numerous small individuals which fill up all the gaps. Those on the margin show tentacles with small wart-like pinnules arranged in two rows. In a polyp 2 mm. long the tentacles are 0·8 mm. in length, and show two rows of pinnules on each side with seven pinnules in each row, leaving a narrow bare space on the oral and a broad bare space on the aboral surface. Towards the centre of the crown the majority of the small polyps show no trace of tentacles or pinnules, but exhibit only a slight tendency to be lobed at the margin. These are usually 4·5 mm. in length and have semitransparent walls.

Locality. Towards Kiungani, just below low tide in a fathom or so of water. Previously recorded from Zanzibar and Port Denison.

As this seems to be a variable species, we add a few notes in regard to other specimens:—

- (*a*) The colour of some when alive was blue all over; the colour of the preserved specimens may show a tint of green or may be pure white.
- (*b*) The size of the larger zooids is variable, *e.g.* in length and breadth in millims. 20 × 2·5, 15 × 2, 7 × 1·5.
- (*c*) No importance need be attached to cases where there seem to be five pinnules abreast on one side of a tentacle, since these trivial deviations occur in colonies where the normal number of four rows is thoroughly dominant.
- (*d*) Another set of specimens was marked by the following peculiarities:—(1) Somewhat slender stalks, 17–25 mm. in height, rise from a flat spreading membrane. (2) The pinnules, which are mostly absent, seem to have been decidedly shorter than the normal, a deviation which is also noted by May; but it is difficult to say how much of this is purely artificial. (3) The calcareous bodies mentioned by Kölliker, but not found by May, are abundant. They are either spherical or roundish oval in shape and highly refractive, with a diameter of about 0·001 mm. Some yellowish spherical zoochlorellæ, about 0·36 mm. in diameter, are also present.

Locality. Zanzibar Harbour, lowest tide-level.

CESPITULARIA CŒRULEA May.

(1) A much-branched colony which was, when alive, of "a brilliant sea-green colour, except the upper faces of the small zooids which were brown." It seems to be referable to May's *Cespitularia cærulea*, which is described, however, as "flesh-coloured with a tinge of bright blue."

This specimen agrees with May's diagnosis in having

(1) One row of pinnules on each side of the tentacles;
(2) Polyp-bodies about 4 mm. in length;
(3) Tentacles about 2·5 mm. in length;
(4) No calcareous bodies.

The mode of branching, on the whole, corresponds with May's description; but there is this noteworthy peculiarity, that one division of the colony is sometimes connected with the main mass by a narrow isthmus, *e.g.* 10 mm. in length by 1 mm. in breadth.

(2) Another colony rises from a flattened base which spreads over a part of the surface of a shell, the rest being covered by a sponge. When alive it was described as having "pink stems with slender brown zooids." The preserved specimen had at first a greenish tinge, which was afterwards replaced by the usual dull creamy white.

The stalk, which soon branches, is fairly firm in texture, but there are no calcareous corpuscles.

Near the base it gives off a small branch which has spread over a flattened surface, and looks very like a *Clavularia* or a *Sympodium* in the arrangements of the polyps on the upper surface. The principal stalk soon divides into two branches, each of which divides several times and bears the polyps.

The polyps are about 5 mm. in length, and slightly under 1 mm. in breadth, and have bushy heads, caused by the feather-like tentacles. The latter are about 3 mm. in length.

The pinnules are arranged in one row (15–18) on each side, thus leaving on both the oral and the aboral surface a free space which runs the whole length of the tentacle. The pinnules are long and slender, often about 1 mm. in length by 0·1 mm. in diameter at the base and 0·05 mm. in diameter at the tip.

Although this specimen differs from (1) in colour (when living) and in mode of branching, the polyps are closely alike.

Locality. Off the Zanzibar coast, a few miles south of the town; 5 fathoms. Previously recorded from Zanzibar and Kokotoni.

(3) A third specimen was described in the living state as having "a pink body with blue-green zooids"; when preserved it had a clear white colour. The base is formed by the end of the stalk growing round a piece of coral.

The stalk is firm in texture, dividing at a little distance above the base into three main branches, each of which divides and redivides into the polyp-bearing portions.

The polyps measure 3·5–4·5 mm. in length with an average diameter of nearly 0·1 mm. The tentacles often appear blunt and short, but this is merely the contracted condition, as other parts of the colony show. Sixteen contracted pinnules were counted on each side.

Locality. Kiungani, near Zanzibar town; lowest tide.

It may be of use to emphasize the point that these three specimens presented when living somewhat different coloration:—

> (1) "A brilliant sea-green colour, except the upper faces of the small zooids, which are brown"; (2) "pink stems with slender brown zooids"; (3) "pink body with blue-green zooids." May's specimens were "flesh-coloured with a tinge of bright blue."

This may be enough to show that the natural colours of *Cespitularia* are of little specific moment.

(4) In a fourth specimen the lower end of the stalk spreads over a piece of calcareous conglomerate. The stalk is firm and marked by longitudinal ridges and grooves; it divides into branches, which at some parts bear the polyps themselves, and at others divide into small polyp-bearing branches. The polyps are, on an average, 3·5 mm. in length by 1 mm. in breadth. On the tentacles, which are 1·5 mm. in length, the small pinnules (0·04–0·045 in length) are arranged in one row on either side of the middle line, thus leaving on the aboral surface a broad, and on the oral a narrow free space which stretches the whole length of the tentacle.

Family ALCYONIIDÆ.

Alcyonium pachyclados Klunzinger.
Sinularia brassica May.
„ *fungoides*, sp. n.
Sclerophytum polydactylum (Dana).
„ *querciforme* Pratt.
„ *marenzelleri* Pratt (= *Lobophytum marenzelleri* ?).
„ *hirtum* Pratt.
„ *viride*, sp. n.
Lobophytum pauciflorum Ehrenberg.

ALCYONIUM PACHYCLADOS Klunzinger.

This species is represented by several typical, much-lobed, almost rigid specimens of a greyish-white colour, with a greenish tint in the surrounding spirit (due to zoochlorellæ?). The colour was originally like "cocoa-and-milk" and the expanded polyps were dark brown.

A short stalk of about 10 mm. rises from a broad base, and bears several broad lobes, each divided into blunt finger-like lobules covered with polyps. The surface of the cœnenchyma exposed when some of the polyps are removed is granular with numerous small elliptical spicules. The tentacles are not dark in colour, as in Klunzinger's specimens; they bear on their oral surface 30–40 short pinnules, usually in four rows, but some more fully expanded showed only two rows, one on each side. The superficial spicules are small ellipses and figure-8 forms; the deeper spicules are for the most part relatively large, spinose, double clubs and double spheres. The following measurements were taken of length and breadth in millims.:—0·09 × 0·05; 0·075 × 0·045; 0·07 × 0·04; 0·06 × 0·02; 0·05 × 0·015. We find more variety in size than Klunzinger indicates, and some of the shapes are exactly like those seen in adjacent species, such as *A. brachyclados*, *A. digitulatum*, *A. sphærophorum*. It seems to us that there is very little difference between the members of this group of species.

Numerous ova occur in the lower parts of the polyps.

Locality. Covering the shore at one place near Wasin; also at Kiungani, Zanzibar. Previously recorded from the Red Sea, Luzon, Zanzibar.

SINULARIA BRASSICA May.

This species is represented by a complete specimen, which is about 50 mm. in height and 38 mm. in width across the capitulum. The stalk of the colony is firm and erect, the surface granular. The capitulum is divided into three branches or lobes, each of which breaks up into a large number of small knob-like bodies.

The autozooids are abundant, but are either completely withdrawn or just show the tentacles above the general surface. Numerous small spicules are found in the autozooids when they are dissected out.

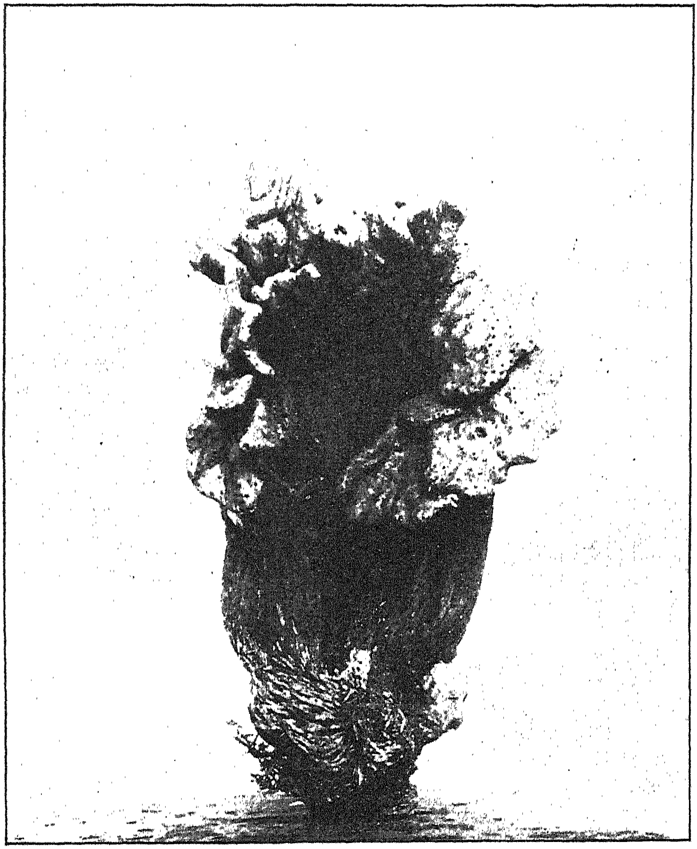
A young colony, with similar spicules and autozooids, is mushroom-shaped with a small capitulum, on which the autozooids are more numerous at the margin than in the centre. The capitulum is somewhat oval in shape, 9 mm. in length by 7 mm. in breadth. The stalk is long and irregular in shape.

Locality. Wasin Channel, 10 fathoms. Previously from Tumbatu.

SINULARIA FUNGOIDES, sp. n. (Text-fig. 85.)

This species is represented by a large brownish colony, which is tough in texture, rigid, and erect.

Text-fig. 85.



Sinularia fungoides, sp. n.

On the outer surface of the much-wrinkled trunk there is a thick coating of large spicules, either lying on, or protruding from, the surface, many reaching a length of 6 mm.

On the capitulum, which is thin with incurved edges, the autozooids appear usually in small groups of twos or threes. Each group is generally elevated on a small protuberance, or each autozooid may have a slight elevation of its own. On the edge of the capitulum the autozooids are more numerous, and they do not occur in groups nor are they raised above the general surface.

The spicules are of two distinct types—(1) large spindles, either straight or slightly curved, closely covered with small, rough, wart-like projections; and (2) small spicules which vary from spindles to rods, with rough prominent projections, which often cluster more closely at one end, thus giving a club-shaped appearance. Their measurements are as follows:—

(1) Length varies from 1–4·6 mm. and the breadth from 0·15–0·55 mm.

(2) Length varies from 0·1–0·5 mm. and breadth from 0·03–0·075 mm.

Locality. Wasin, 10 fathoms.

SCLEROPHYTUM POLYDACTYLUM Dana. (Plate XXXI. fig. 2.)

A complete specimen 75·5 mm. in height. The lower part of the stalk is very rigid, with spicules readily visible to the naked eye. The upper part is marked by longitudinal grooves and folds, and is devoid of the larger spicules which are present in the lower part.

The capitulum is divided into a large number of small, blunt, finger-like lobes, on which the autozooids seem to be almost equally distributed.

The numerous small autozooids are almost all completely retracted, a few can be seen with the tentacles appearing above the surface. The tentacles are short (0·6 mm.) and thick, with the pinnules arranged in one row on either side of the middle line of the oral surface. The eleven pairs of pinnules are small, cylindrical, and rather blunt.

The spicules:

I. Of the upper part of stem:—

(*a*) Large straight or curved spindles covered with many rough tubercles, varying from 0·6–2·7 mm. in length and from 0·15–0·5 mm. in breadth.

(*b*) Small straight or irregularly-shaped spicules with large rough spines, varying in length from 0·1–0·35 mm. and in width from 0·02–0·09 mm.

(*c*) Straight spicules with very few smooth spines, varying in length from 0·2–0·7 mm. and in width from 0·075–0·15 mm. They often show slight traces of four rays, and these show a **X**-marking at the junction of the rays.

II. Of the lower part of the stalk:—

The same types of spicules are present, but there is a marked predominance of (*a*). They are more varied here and often show branches or projections. (*b*) and (*c*) are also present, but in both cases there is more variation in the size and shape. The **X**-shaped marking is more frequent.

III. In the capitulum :—

The second type (*b*) is predominant. They are often branched and the 4-radiate forms are common. In many of them the rough spine-like processes are restricted to one end, and the other end tapers to a point and is free from spines.

Locality. Zanzibar. Previously from Red Sea, China Straits, British New Guinea, Maldives, Gulf of Manaar.

SCLEROPHYTUM QUERCIFORME Pratt.

This species is represented by two fragments.

The stalk is firm and rigid, with the core packed with large spicules. The outer surface of the stalk is granular. From the broken lower end of both fragments large spicules project.

The capitulum is divided into large lobes, which are in their turn divided into very numerous smaller lobes. The polyps are borne principally on the smaller lobes, but many are present on the sides of the larger lobes and on the continuation of the stalk.

The stem-spicules are thick spindles with numerous rough wart-like spines, and slender spindles with numerous rough spines. They vary in length from 0·18–0·23 mm. and in width from 0·03–0·05 mm.

The polyp-spicules are slender spiny spindles, varying in length from 0·12–0·4 mm.

Clubs 0·2–0·25 × 0·1 mm.

Previously from Maldives and Gulf of Manaar.

SCLEROPHYTUM MARENZELLERI Pratt.

A small complete colony, firm and rigid with a much plicated crown. It is 16 mm. in height, and the crown has a breadth of 29 mm. The autozooids appear to be restricted to the top of the folds on the crown and to the margin. The surface has a granular appearance due apparently to the numerous minute siphonozooids. In the crown large white spicules covered with numerous small tubercles are seen projecting often to a distance of 3 mm.

SCLEROPHYTUM HIRTUM Pratt.

A specimen firm and tough in texture, with a total height of 16·5 mm. and a maximum coronal breadth of 20·5 mm. The crown has a large number of small lobes. The autozooids are completely retracted and the lobes have a warty appearance.

From the broken base of the specimen numerous large spicules project. They are spindle-shaped, straight or curved, thickly covered with numerous rough warts, and often show a tendency to divide into several branches. The following measurements were taken of length and breadth in millims.:—3·3 × ·5; 2·6 × ·35; 3·35 × ·55.

A vertical section of the specimen showed numerous yellow ova, with a diameter of 0·7 mm.

SCLEROPHYTUM VIRIDE, sp. n. (Plate XXIX. figs. 2 & 3.)

(1) This species is represented by numerous portions of very large colonies. Some of the colonies were a yard across! In the living forms the general colour was bright green, the polyps were brown, the tentacles green. The stalk in one specimen is 34·5 mm. in height and in the other 30 mm. The portion of the crown is greatly folded and lobed, each of the larger lobes dividing into smaller lobes.

In the majority the autozooids are completely retracted within the general cœnenchyma, but they are very numerous, especially towards the edge of the marginal lobe. The pores left by the retracted autozooids are variable in size, some 0·15 mm. × 0·1 mm., others 0·075 mm. × 0·075 mm., and others 0·1 × 0·075 mm. Their shape also varies from a circular opening to a somewhat oval-shaped pore.

Between the openings of the autozooids lie the numerous very minute openings of the siphonozooids, becoming more numerous in proportion to the autozooids towards the central portion of the crown.

The spicules are of three types:—

(*a*) Long slender spindles with few rough wart-like tubercles, in length and breadth in millims. as follows: 0·45 × 0·06; 0·3 × 0·03; 0·2 × 0·025.

(*b*) Short, thick, double clubs with a very short median waist and with whorls of rough wart-like tubercles which carry a number of small spines. They vary in length from 0·25–0·3 mm. and in breadth from 0·12–0·2 mm.

(*c*) Small oval-shaped spicules with many tubercles as in (*b*), varying in length from 0·25–0·39 mm. and in breadth from 0·1–0·2 mm.

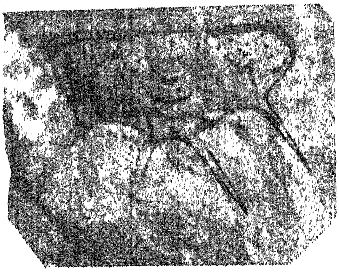
The last type (*c*) may be a modification of (*b*) in which the free central portion has become obliterated. Among the first type (*a*) several show bifurcations at the ends.

(2) In some other less contracted specimens the autozooids are numerous, up to 7 mm. in length including the tentacles, and are all marked by transverse annulations. On the tentacles the pinnules are arranged in one row on either side of the middle line on the oral surface; the number in a row varies from 10–14. The tentacles are short (about 1 mm.) in comparison to the polyps. The stomodæum, which is greatly wrinkled, is 1·6 mm. in length.

The siphonozooids are very numerous and small, giving the surface a pitted or dotted appearance.

The spicules are of three types:—

(*a*) Long slender spindles with very few and wart-like tubercles, from 0·2–0·3 mm. in length and from 0·025–0·03 mm. in width.



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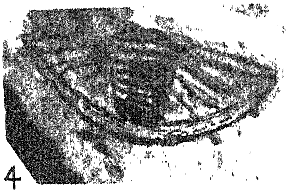

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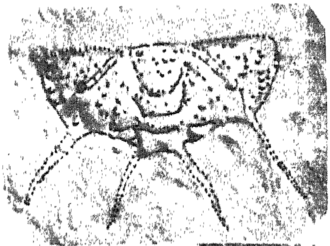

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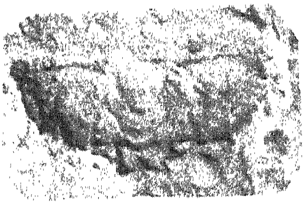

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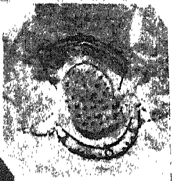

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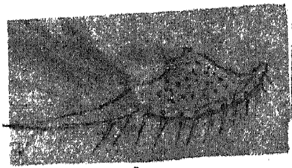

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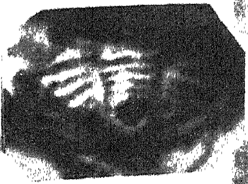

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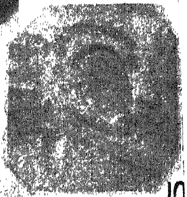

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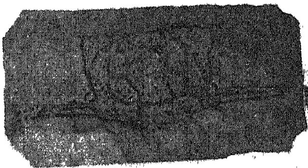

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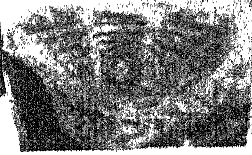

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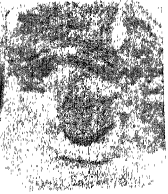

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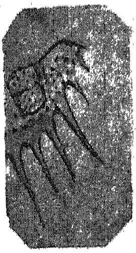

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6

4

Trilobites from N.S.W.

(*b*) Thicker double clubs with whorls of rough wart-like tubercles, from 0·15–0·3 mm. in length and from 0·035–0·08 mm. in width. In some there is so little waist that the appearance is almost spindle-shaped.

(*c*) Thicker and blunter rod-shaped spicules with large and very rough wart-like tubercles, length and breadth in millims.:—0·22 × 0·1; 0·3 × 0·15; 0·2 × 0·16.

Of the last set (*c*) some are almost globular in form, owing to the strong development of the wart-like tubercles. Among them there are also a few six-sided flat plate-like scales which have a maximum length of 0·14 mm. and a maximum breadth of 0·11 mm.

Locality. Kiungani, near Zanzibar, and wherever coral abounds.

LOBOPHYTUM PAUCIFLORUM Ehrenberg.

Large brown specimens of this widely distributed species were found at Stations 13 and 16.

Family 3. NEPHTHYIDÆ.

Subfamily SPONGODINÆ.

Nephthya zanzibarensis, sp. n.
,, ,, var. *mollis*, nov.
,, *armata*, sp. n.
Spongodes hemprichii Klunzinger.
,, *crosslandi*, sp. n.
,, *zanzibarensis*, sp. n.
,, *kükenthali*, sp. n.
Stereonephthya zanzibarensis, sp. n.
Lithophytum elegans (Kük.) = *Ammothea elegans* May.
,, *viride* (Kük.) = *Ammothea viridis* May.
,, *brassicum* (Kük.) = *Ammothea brassica* May.
,, *ramosum* (Quoy et Gaimard).
,, *thyrsoides* (Kük.) = *Ammothea thyrsoides* Ehrenberg.
,, *thrysoides* (Kük.), var. *durum*, nov.
,, *flavum* (May).
Paraspongodes striata Thomson & Henderson.

Subfamily SIPHONOGORGINÆ.

Siphonogorgia intermedia, sp. n.

Subfamily SPONGODINÆ.

NEPHTHYA ZANZIBARENSIS, sp. n. (Plate XXVII. fig. 3.)

Two yellowish-white colonies, one attached to a monocotyledonous twig, the other to a leaf. They are respectively in height and breadth, 4 by 3, and 5·5 by 4 centims. The whole colony in its preserved state is flaccid, but is densely covered by a layer of small white spindles with numerous larger ones distributed irregularly over them.

The main stem gives off elongated conical branches, and these bear, especially on their lateral surfaces, numerous finger-shaped lappets covered with polyps.

The Stützbündel consists of 5, 6, or 7 straight warty spindles; the polyp-stalk is covered by regularly arranged closely-fitting small spindles; the anthocodiæ are at right angles to the Stützbündel and are directed inwards towards the general surface of the colony. On the anthocodia there are eight double rows of ten to twelve spindles in each row; the opposite spindles in the double row converge and the whole double row tends to stand out like a ridge on the surface. There is no sign of spicules on the tentacles.

This species resembles *N. cupressiformis* Kükenthal in general appearance, but the polyp-bearing lobes are more finger-like, and both the general spiculation and the architecture of the anthocodiæ are quite different.

Locality. Wasin Channel, 10 fathoms.

NEPHTHYA ZANZIBARENSIS, var. MOLLIS, nov. (Plate XXVII. fig. 5.)

A somewhat flattened whitish-grey colony, 7 centims. in height by 3·5 centims. in maximum breadth and about 1 centim. in thickness. At a short distance from the base it gives off a strong side branch, and both it and the main stem bear numerous elongated finger-like lobes or secondary branches bearing these. Almost all the branches and lobes are developed to the sides. The colony is soft and flaccid, but the general cœnenchyma is covered with a feltwork of transversely-disposed colourless spiny spindles (0·2 to 0·9 mm. in length) which give it an almost striated appearance. No other type of spicule was to be found in the colony.

The polyps stand almost at right angles to their short stalks; the Stützbündel is composed of about four to six straight spindles (0·75 and 1·25 mm. in length), one of which projects for about 0·25 mm. The anthocodia is supported by eight double rows of about ten spicules in each row.

This form is characterised by the absence of the irregular superficial layer of spicules and by its darker colour, so that we feel justified in making it a new variety.

Locality. Wasin Channel, 10 fathoms.

NEPHTHYA ARMATA, sp. n. (Plate XXVII. fig. 4.)

A stiff colony of a drab-grey colour, 3·5 centims. in height, 3·5 centims. in maximum breadth, and 2 centims. in thickness. A short trunk bears five main branches, from which arise numerous blunt and short finger-like lobes.

The polyps are not densely crowded, but form an irregular spiral on the lobes. In every case the mouth is turned inwards. There is a well-developed Stützbündel, often with four strong spindles and sometimes projecting for about 0·5 mm. The Stützbündel spicules vary from 0·8 to 1 mm. in length and have an average diameter of 0·1 mm. They are straight warty spindles. Covering the anthocodiæ there are numerous small spindles arranged in double rows; the average dimensions are 0·5 mm. in length and 0·06 mm. in breadth. There are also minute spicules on the tentacles, horizontally disposed in two rows.

A prominent feature is that the general cœnenchyma bears very large transversely-disposed spindles, which give it a wrinkled appearance. The following measurements in millims. were taken:—2·6 × 0·2, 2·4 × 0·19, 1·6 × 0·16, and 1·4 × 0·15. No other forms of spicules were to be found in the colony.

This species should be referred to a position near *N. digitata* Kükenthal.

Locality. Wasin Channel, 10 fathoms.

SPONGODES HEMPRICHII Klunzinger.

A form closely resembling this species, but the spicules are not red. The trunk has a leathery and rigid character and is rough in appearance, the larger spicules being easily seen. At its lower end it gives off a number of rhizoid-like offshoots, by means of which it is anchored in the sand. The colour in spirits is yellowish white, but in the living colony was a weak chocolate. One colony is 7 centims. in height, 6 in breadth, and 2·5 in thickness, while the corresponding measurements for another are 5, 7, and 3·5 centims. The stem divides almost immediately into three chief divisions, which bear numerous conical lobes densely covered with polyps.

In architecture the polyps agree closely with the description given by Kükenthal of *S.* (*Dendronephthya*) *hemprichii.* Each double row of spicules on the anthocodia consists of four to six pairs, but five seems to be the commonest number. We cannot attach much importance to the fact that the spicules are not red as they are in the type, for the colour of the spicules in *Spongodes* is often variable. In *S. kükenthali*, sp. n., we found red, yellow, orange, and colourless spicules. The spicules are long spindles, either straight or curved, and covered with numerous rough spines which are often branched. Their measurements, length by breadth in millims., are as follows:—

Stützbündel spicules: 2·2 × 0·14; 2·4 × 0·15.

Other spicules: 2·6 × 0·18; 2·2 × 0·14; 2·3 × 0·15; 0·3 × 0·03.

Locality. Wasin Channel, 10 fathoms; very common at lowest tides and below. Previously recorded from the Red Sea.

SPONGODES CROSSLANDI, sp. n. (Plate XXVIII. fig. 2.)

A complete small colony of apparently divaricate type, 13 mm. in height by 12 mm. in breadth and 7 mm. in thickness. A short trunk gives off three main branches, which redivide and finally bear the polyps in bundles of 6–10, though a few also occur singly. The general colour of the surface is warm orange, but the anthocodiæ and tentacles are covered with chalky-white spicules.

Almost all the polyps are directed towards one of the two flattened surfaces.

The polyp-stalk is about 1·5 mm. in length, and is loosely covered with longitudinally disposed spicules. On the anthocodiæ there are eight double rows of spicules with about eight in each row. Two or three pairs at the top of each row are longer than the others and converge into a triangular projecting point. The orange-coloured Stützbündel spicule projects slightly beyond the anthocodia for about 0·5 mm. The anthocodia has a rounded cauliflower-like form, and the tentacles are neatly incurved on the oral surface, exposing aboral rows of white spicules transversely arranged. The armature of the polyp is the distinctive feature of this species.

Locality. Mouth of Wasin Harbour, 10 fathoms.

SPONGODES ZANZIBARENSIS, sp. n. (Plate XXVIII. fig. 1.)

An incomplete specimen of a beautiful colony, predominantly of a canary-yellow with pink polyps. It belongs to the divaricate section of the genus, and as the contour is irregular and the polyparium flattened it should be referred to Kükenthal's *cervicornis* group. The dimensions are 2·5 centims. in height, 2·5 centims. in maximum breadth, 0·8 centim. in thickness.

The polyps are by no means crowded, and occur singly or in bundles up to seven in number. Their stalks are short, about 1 millim. in length; their mouths are directed inwards and downwards: the Stützbündel has a pair of projecting pink or yellow spicules extending for about 0·5 mm. beyond the anthocodia. On the wall of the anthocodia there are eight double rows of about ten pink spicules in each row; those on opposite sides converge, and each row ends in a triangular point. The tentacles bear a transverse series of yellowish spicules. Over the general surface there is a loose network of large, curved, yellow spindles, below which there is a crowded stratum of small semitransparent forms.

All the spicules are spindles with numerous small spines. The following measurements of spicules were taken:—(*a*) Stützbündel 3×0·15; (*b*) superficial spindles 2·5×0·12; (*c*) pink spindles of anthocodiæ 0·9×0·08; (*d*) subjacent cœnenchyma spicules 0·2×0·03.

This form does not agree with any of the short-stalked species in the *cervicornis* group.

Locality. Wasin Channel, 10 fathoms.

SPONGODES KÜKENTHALI, sp. n. (Plate XXXI. fig. 5.)

A very beautiful species which seems to be referable to a position near *S.* (*Dendronephthya*) *coronata*. It belongs to the umbellate type, is slightly flattened, and has an approximately regular outline. Its dimensions are 6 centims. in height, 6·5 in breadth, and 3·75 in thickness. The stem and branches are very rigid; five of the lower branches are foliate and nearly encircle the stem; the stem gives off a large number of primary branches which break up into secondaries and these bear the twigs with umbels of polyps. The trunk and base are wanting. The spicules on the surface of the general cœnenchyma are transparent near the base and pale yellow higher up. Just below the polyp-bearing twigs some of the yellow spicules show a red core, and there is thus a gradual transition to the crimson-red spicules of the polyp-stalk, anthocodia, and tentacles.

The polyps are arranged in small clusters of 7–10; and these are again grouped into larger umbels. Though there is no crowding, the polyps form a fairly continuous covering. A polyp is usually about 1·5 mm. in length and is covered by longitudinally disposed spindles. Three large ones form a strong Stützbündel which projects beyond the anthocodia for about 1 mm. The anthocodia stands almost at right angles to the polyp-stalk, and is supported by red spindles in 8 double rows, about 7 pairs in each row. A distinctive feature is that the topmost spicules of each double row project in triangular points beyond the bases of the tentacles. The tentacles are white, but bear numerous small red spicules arranged transversely, so that a fine tentacular operculum is formed over the contracted polyp.

The spicules are spindles with fine warts or short blunt spines, and show a great range of colour. Some are red, some are yellow, some are combinations of these colours, and others are transparent. The largest are those of the Stützbündel, about 4 mm. in length by 0·2 in breadth, and some of those on the polyp-stalk are about 3·5 mm. in length. Those of the general surface of the cœnenchyma are: 2 × 0·15 mm.; 1·8 × 0·15; 1·5 × 0·1; 1·35 × 0·1; 0·8 × 0·1; 0·35 × 0·04; 0·3 × 0·03.

The red spicules of the anthocodiæ are mostly about 0·6 × 0·04; a projecting one had a length of 1·2 × 0·06.

Locality. Wasin.

STEREONEPHTHYA ZANZIBARENSIS, sp. n. (Plate XXXI. figs. 3 & 4.)

A small but complete colony of a yellowish tint, 10 mm. in height and 8·5 in breadth. The trunk of the colony is limp, but the main polyp-bearing part is stiff and brittle. The polyps have short stalks about 1 mm. in length; some arise from the trunk, but most are borne on the branches. They occur close together, but are not united into bundles. The anthocodia stands at right angles to the stalk and has its oral opening directed towards the branch. The Stützbündel has one main projecting spicule (1·2 × 0·125 mm.) supported by 2 or 3 bent spindles on either side; below these there are a few in the direct line of the projecting spicule, passing continuously into the superficial spicules of the cœnenchyma (0·6, 0·4, and 0·25 mm. in length). On the anthocodiæ there are eight double rows of spindles, each row consisting of 15–20. The opposite members of a double row slope towards one another at an acute angle, which widens towards the base. On the tentacles there are transverse rows of spicules. All the spicules are warty spindles.

As there is no sign of the union of the polyps into bundles, this form cannot be referred to the genus *Spongodes* (Kükenthal's *Dendronephthya*). It falls rather into the old genus *Spongodia*, one of the features of which was the occurrence of isolated polyps. This is now termed *Stereonephthya* by Kükenthal, and defined as follows:—

Very stiff Nephthyidæ, whose polyps are not disposed in lappets or bundles, but occur singly or in small groups directly on the stem or on the main branches, which have few twigs or none. Polyps with Stützbündel.

The spiculation of the anthocodia (15–20 pairs of spicules in each double row) is one of the well-defined diagnostic features distinguishing this form from the eight species recognised by Kükenthal.

Locality. Zanzibar, Chuaka.

LITHOPHYTUM ELEGANS (Kükenthal) = AMMOTHEA ELEGANS May.

In this specimen the polyps vary from 1·1–1·25 in length and have a diameter of 0·7 mm. The polyp-spicules vary from 0·16–0·17 mm. in length with a diameter of 0·01 mm.; the stem-spicules vary in length from 0·3–0·4 mm., and in breadth from 0·01–0·02 mm. The colour of the specimen when living was pink with brown zooids.

Locality. Zanzibar Channel, 10 fathoms, also Chuaka Bay, East Coast of Zanzibar. Previously recorded from Tumbatu, an islet near Zanzibar.

LITHOPHYTUM VIRIDE (Kükenthal) = AMMOTHEA VIRIDIS May.

This species is represented by several specimens, which agree in every detail with the description given. The polyp-spicules vary in length from 0·1–0·24 mm., and in breadth from 0·015–0·03 mm. The stem-spicules vary from 0·08–0·18 mm. in length and from 0·04–0·06 mm. in breadth. The spicules in the inner canal-walls of the stem are in length and breadth, in millims.:— 0·54 × 0·12; 0·3 × 0·067; 0·4 × ·07.

Locality. Wasin, 10 fathoms. Previously recorded from Bani and Muemba.

LITHOPHYTUM BRASSICUM (Kükenthal) = AMMOTHEA BRASSICA May.

This species is represented by one specimen, which agrees very closely with the type. The polyps vary from 1–1·2 mm. in length and from 0·6–0·7 mm. in breadth. The polyp-spicules vary from 0·12–0·34 mm. in length, and in breadth from 0·016–0·02 mm.; the stem-spicules, which are slender with few wart-like spines, vary in length from 0·14–0·4 mm. and in breadth from 0·02–0·03 mm. Mr. Crossland describes the colour of the living specimens as "weak cocoa."

Locality. Zanzibar; very common among *Zostera* at low spring-tide. Previously recorded from Baui, an islet in Zanzibar Harbour.

LITHOPHYTUM RAMOSUM Quoy et Gaimard.

A well-preserved specimen of this species showed no trace of any spicules even in the canal-walls. The colour of the preserved specimen is yellow-grey.

Previously recorded from Zanzibar and New Guinea.

LITHOPHYTUM THYRSOIDES (Kükenthal)=AMMOTHEA THYRSOIDES Ehrenberg.

Several fine specimens of this common species, all belonging to what Kükenthal calls the asparagus-like variety—that is to say, with cylindrical stalks rising parallel to one another and united by a common basis. The colour of the preserved specimens is yellowish white, in life it was brownish. One of the distinctive features of this species is that the polyps arise directly from the ends of the stalks. The polyps are from 2–3·5 mm. in length by 1–1·2 mm. in breadth.

The spicules of the stalks and polyps are very slender spindles with few warts. The following measurements were taken of length and breadth in millims.:—(*a*) polyp-spicules: 0·09 × 0·01, 0·12 × 0·012, 0·18 × 0·016, 0·2 × 0·017, 0·25 × 0·016, 0·28 × 0·016; (*b*) stem-spicules: 0·12 × 0·016, 0·16 × 0·016, 0·3 × 0·02, 0·35 × 0·02, 0·4 × 0·02.

Locality. Zanzibar. Previously recorded from Tumbatu Island, on the N.W. coast of Zanzibar, and from the Red Sea.

LITHOPHYTUM THYRSOIDES (Kükenthal), var. DURUM, nov.

From a flat spreading base a large number of almost hemispherical lobes arise. Each lobe is closely covered by the projecting calycine portions of the polyps. The colour of the colony is pale orange. The cœnenchyma has a gritty structure, with fairly abundant spicules. The spicules of the cœnenchyma are long slender spindles, either straight or slightly curved, with small spines arranged irregularly or in whorls. Their length varies from 0·15–0·4 mm., and their width from 0·02–0·03 mm.

Locality. Zanzibar, among coral, low tide.

LITHOPHYTUM FLAVUM (May).

The species *Lithophytum africanum*, *L. flabellum*, and *L. flavum* seem to form a close group connected by intermediate forms. There are several specimens in the collection which closely approach *L. flavum*, but differ from it in being far from rigid and in having few spines on the spicules. We see no reason to emphasise this quantitative distinction, especially as the boundaries of the three species referred to are somewhat elastic. Their common features are that several cylindrical stalks spring from a common base, that the polyps are borne on short twigs springing from the ends of the stalks, that the stalks are united with one another for a variable distance, and that the polyps are restricted to the upper regions.

In representative specimens there are several upright branches dividing into finger-shaped ends, which bear numerous polyps not densely disposed. One colony is 6·5 centims. in height and 5 centims. in breadth at the top. The whole colony is soft and compressible, with longitudinal grooves corresponding to the canals. The preserved specimens are whitish yellow.

The spicules are long slender spindles with very few small and distant spines. The polyp-spicules vary from 0·12–0·3 mm. in length and from 0·01–0·02 mm. in breadth; those of the stem from 0·16–0·3 mm. in length and 0·016–0·02 mm. in breadth.

Locality. Zanzibar. Previously recorded from Tumbatu Island, off Zanzibar.

PARASPONGODES STRIATA Thomson & Henderson.

A very fine specimen, 15 centims. in height by 12 centims. in maximum breadth. In its preserved state it is quite flaccid and has an umber-brown colour. The polyps are borne in bundles of 9–21; all the polyps in a bundle reach nearly the same level. They are about 1 mm. in length and 0·75–0·9 mm. in breadth.

The polyp-spicules are slender spindles, usually straight and covered with few warts. They are from 0·16–0·4 mm. in length and from 0·015–0·04 mm. in breadth. The stem-spicules may be divided into three groups:—(*a*) long slender spicules with few spines, from 0·3–0·9 mm. in length and from 0·02–0·035 mm. in width; (*b*) ball-like spicules with many prominent spines; and (*c*) small irregular **X**-shaped spicules, very rough and with prominent spines. The two last types vary in length from 0·06–0·2 mm. and in breadth from 0·04–0·12 mm.

Locality. Wasin, 10 fathoms. Previously recorded from the Gulf of Manaar.

Subfamily SIPHONOGORGINÆ.

SIPHONOGORGIA INTERMEDIA, sp. n. (Plate XXX. figs. 1 & 2.)

The most puzzling specimen in the collection is a small cream-coloured colony, with four finger-shaped lobes on a short trunk. On each lobe there are a few relatively distant polyps occurring all round. Most are well-expanded, but some are all but completely retracted into the cœnenchyma.

At first sight the colony suggested a small *Alcyonium*; but the polyps have a well-developed anthocodial armature, and the walls of the stem-canals are supported by numerous spicules, some very large. Moreover, the whole somewhat granular surface is covered with a delicate but coherent layer of small spicules.

The anthocodial part of the polyp is supported by eight triangles of sloping spindles, which diverge into a brush-like apex at the base of each tentacle. In some there were 4–5 distinct pairs of spicules in the triangular sheaf. The triangles rise from a transverse ring of about three rows of spindles.

The cortical spicules are slender spindles with a few rough warts. A common size was 0·8 mm. in length by 0·06 mm. in breadth. The inner spicules of the stem are strong spindles closely covered with rough warts. They vary greatly in size and in the number of warts; some bear fine spines, and some are bifid or slightly branched at one end. A common size is 2·6 mm. by 0·175 mm.

Probably the specimen is a young form, and we found no trace of ova. It seems to us undoubtedly a Siphonogorgid, perhaps intermediate between *Siphonogorgia* and *Chironephthya*; but it is quite unlike any form known to us. With much hesitation we have, for convenience of reference, named it *Siphonogorgia intermedia*.

Locality. Zanzibar shore.

Order III. PSEUDAXONIA G. von Koch.

Family Sclerogorgidæ.

Suberogorgia köllikeri Wright & Studer, var. *zanzibarensis*, n.

Family Melitodidæ

Wrightella erythræa Gray = *Mopsea erythræa* Klunzinger.
,, *variabilis*, sp. n.

Family Sclerogorgidæ.

Suberogorgia köllikeri Wright & Studer, var. zanzibarensis, n. (Plate XXIX. fig. 4.)

(A.)—A small fragment consisting of a part of a stem or branch from which two lateral branches are given off on the same side. The stem or branch and the lateral branches are all compressed in the plane of branching. The branches come off at an angle which approaches 90°, and then turn upwards and run roughly parallel to the main stem or branch. On both surfaces of the main and lateral branches there is an irregular groove which in some parts almost disappears, being marked only by a narrow strip of colourless spicules. The verrucæ are arranged in a single row on each of the lateral surfaces; they are disposed alternately, though at some places they are almost opposite; they are small, and appear as low rounded swellings on the sides.

The polyps are completely retractile, and are white in colour. In the tentacles, which are short, there are small rod- or spindle-shaped spinose spicules which are from 0·08–0·12 mm. in length and have an average diameter of 0·02 mm.

The spicules of the body of the polyp are flattened sword-shaped bodies with rough warts or teeth on the edges, and may be either straight or slightly curved.

The spicules of the general cœnenchyma are all of one type—spindles covered with rough warts, which are arranged in regular whorls, and often blunt at both ends. Some of the spicules are yellowish-amber colour, often almost colourless at the tips; others are quite colourless. Their measurements, length by breadth in millims., are as follows:—

Coloured: 0·2×0·05; 0·12×0·06; 0·16×0·05; 0·16×0·04; 0·14×0·05.

Colourless: 0·06×0·03; 0·08×0·04; 0·12×0·05; 0·14×0·05; 0·1×0·04.

Locality. Wasin Channel, 10 fathoms.

(B.)—Another colony forms a thin encrustation on a piece of bivalve shell, about 25 mm. by 30 mm., with nine stems rising at various angles. Three of the stems lie on the under concave surface of the shell and keep close to it; the four longest on the other side extend to 65–80 mm. from the shell. Two have a single branch. The greatest breadth is about 2 mm. There is a slight flattening in the plane in which the polyps for the most part arise. The general colour is a quiet orange. The verrucæ are inconspicuous and for the most part lateral; some of them show eight distinct marginal lobes. The polyps are pure white. A longitudinal groove is distinct for a short distance from the base. The spicules are spindles with warts in whorls 0·12×0·04, 0·14×0·04 mm.; and double spindles 0·13×0·06, 0·12×0·05; and a few small almost orbicular forms.

This form approaches *S. köllikeri* Wright & Studer, but differs from it in the size and prominence of the verrucæ and in the size of the spicules, but it is connected to that species by *Suberogorgia köllikeri*, var. *ceylonensis*. But the Zanzibar form has smaller verrucæ and spicules than the Ceylonese variety, and the series may be regarded as illustrating progressive variation.

Locality. Kokotoni Harbour, Zanzibar West, 5 fathoms.

Family MELITODIDÆ.

WRIGHTELLA ERYTHRÆA Gray = MOPSEA ERYTHRÆA Klunzinger. (Plate XXVIII. fig. 10.)

Small, irregularly branched, rose-red colonies, fixed to coral. The branches are not always confined to one plane. The following measurements were taken of height and breadth in millims.:—15×23; 23×8; 15×8. The specimens agree well with Klunzinger's description of *Mopsea erythræa*, *e. g.* in the presence of a single red spicule at the base of each tentacle and in the dimensions of the spicules generally.

Localities. Wasin, low tide, growing on coral; Prison Island, Zanzibar Harbour. Previously recorded from the Red Sea.

In the Aberdeen University Museum there is a specimen from Samoa which is superficially identical with these. It is labelled *Mopsea erythræa.*

WRIGHTELLA VARIABILIS, sp. n. (Plate XXVIII. figs. 3–9.)

The collection included a considerable number of small delicate Melitodidæ, of beautiful and apparently variable coloration. The branches tend to be compressed; they lie for the most part in one plane; the verrucæ are for the most part lateral; the spicules are warty spindles, straight and curved, sometimes kneed, and clubs with warty expanded ends which are not foliate enough to be called "Blattkeulen." At the same time, the specimens seem nearer the genus *Wrightella* than any other, and till a large number of specimens is available it seems convenient to combine the various specimens in this collection under the common title *W. variabilis.* They differ not only in colour, but in respect to the proportions and warts of their spindles and clubs. Some of the colour-schemes of these closely-related forms are shown in Plate XXVIII. We may readily distinguish: (*a*) a form with a variable combination of red and colourless spicules, with more substantial and shorter branches than the others and a closer approach to *W. erythræa*; (*b*) a form with yellow internodes and the usual brown nodes appearing as red; (*c*) a salmon-coloured form; (*d*) a crimson form with yellow verrucæ; and (*e*) a reddish-brown form with red verrucæ.

Locality. Wasin, among coral, low tide.

Order IV. AXIFERA G. von Koch.

Family GORGONIDÆ.

Leptogorgia ochracea, sp. n.
Lophogorgia crista Möbius.
" *lütkeni* Wright & Studer.

Family GORGONIDÆ.

LEPTOGORGIA OCHRACEA, sp. n. (Plate XXIX. fig. 1.)

This apparently new species of *Leptogorgia* is represented by a beautiful dry specimen, 18·5 centims. in height by 15 in maximum breadth. It has a bright ochreous-yellow colour and expands for the most part in one plane with several anastomoses. The disc of attachment has been separated from the substratum and has been overgrown almost entirely by the cœnenchyma and a Polyzoon.

From the basal expansion, about 22 mm. in diameter and 9 mm. in height, there rises a main stem, 4 mm. in basal diameter, which gives off numerous branches. Just at the base a large branch is given off, so nearly equal to the main stem in diameter (3 mm.) that it might be regarded as of equal importance. The main stem is at first circular, but soon becomes flattened in the plane of expansion; the larger branches are also flattened, but the twigs are cylindrical. There is no particular arrangement of branches, but the tendency to arise on one side, *i.e.* towards vacant space, is well-marked. The tips of the branches end in short sharp-pointed cones, as seen, for instance, in *Leptogorgia australiensis*. On the older branches the cœnenchyma is thin and shows distinct longitudinal grooves, which can be traced up into some of the twigs where the cœnenchyma is much thicker. Under a lens the general texture of the surface is granular. As to the polyps, many show wart-like protruding verrucæ, about 0·5 mm. in height, 0·75 in breadth, and 1 mm. in length, the elongation being in the plane of the branch. In many cases, however, the contraction is complete, and only slit-like apertures indicate the position of the polyps. They may occur at any point, but on the main stem and larger branches they tend to be lateral.

The transparent pale yellow spicules of the cœnenchyma are warty spindles, while some approach a club-shaped form. They have the following measurements, length by breadth, in millims.:—

(*a*) Spindles with warts in whorls: 0·18 × 0·04; 0·16 × 0·05; 0·18 × 0·05; 0·2 × 0·04.

(*b*) Spindles with irregularly-placed warts: 0·16 × 0·06; 0·18 × 0·05; 0·18 × 0·06.

(*c*) Small irregularly-warted spindles: 0·08 × 0·04; 0·1 × 0·04; 0·09 × 0·045.

Locality. Cape Verde Islands.

LOPHOGORGIA CRISTA Möbius. (Plate XXIX. figs. 5–7.)

Two plume-like brownish-red colonies resemble *Lophogorgia crista* Möbius in the following features:—(1) the general habit of the colony; (2) the flattening of the larger branches in the plane of ramification; (3) the nature and thickness of the cœnenchyma; (4) the hint of striations; and (5) the spiculation near the base.

The two colonies measure 34 and 35 centims. in length, 6 and 10 centims. in breadth; the basal (broken) ends 7 and 6 mm. in one diameter and 3·25 and 3·4 mm. in the other.

The spicules from the lower end of the colony are warty spindles, with the warts in 2–4 whorls. They are beautifully coloured, with the spindle-core red and the projecting warts of a pale translucent yellow. The following measurements were taken (in millims.):—

(*a*) Of spindles with two whorls of warts: 0·09 × 0·05; 0·1 × 0·06.

(*b*) Of spindles with three whorls of warts: 0·09 × 0·05; 0·1 × 0·06.

(*c*) Of spindles with four whorls of warts: 0·1 × 0·04; 0·12 × 0·06.

Spicules taken from the tips of the branches are slightly different from those at the base. Many of them are longer, more slender spindles with up to 10 whorls of warts. The following measurements were taken of length and breadth in millims.:—0·18 × 0·04; 0·19 × 0·04; 0·16 × 0·06; 0·13 × 0·06. The majority are coloured like those at the base, but there are also some wholly yellow forms with warts either regularly or irregularly disposed.

These specimens differ essentially from *L. lütkeni* Wright & Studer in the following particulars:—

(1) There is no distinct "irregular wavy line" on the branches.

(2) The polyps are distributed all over the cœnenchyma.

(3) The spicules never exceed 0·19 mm. in length (in *L. lütkeni* up to 0·34 mm.).

(4) The colour of *L. lütkeni* is a dull yellowish red.

From *L. crista* Möbius they also differ in a few details:—

(1) In *L. crista* there are numerous striations on the cœnenchyma especially near the base, but these diminish in number in the younger branches; in our specimen the striations are very faint.

(2) The figures of spicules given by Möbius are not quite like those in our specimen, but the variation in the size and form of the spicules in the different parts of the colony which we have noted in detail has led us to disregard the minor differences. It may be that the spicules described and figured by Möbius were taken from the cœnenchyma near the base.

(3) The colour, both of the specimens themselves and of the spicules, shows a marked difference, but this does not justify their separation from *L. crista.*

Locality. Cape Verde Islands. Previously recorded from Algoa Bay.

LOPHOGORGIA LÜTKENI Wright & Studer.

This species is represented by a piece of a colony 295 mm. in maximum height and 105 mm. in width. It is branched in one plane, with the branches flattened in the plane of branching and marked by a distinct groove along both the flattened faces. The polyps are confined to the lateral surfaces of the branches and twigs; their verrucæ are reduced to slight elevations of the general cœnenchyma. The species is practically identical with the forms which we referred to *L. lütkeni* Wright & Studer (Ceylon Pearl-Oyster Fisheries Reports), and shows the same minor divergences from the type.

Locality. Wasin, British East Africa, 10 fathoms. Previously recorded from Cheval Paar, Gulf of Manaar.

Order V. STELECHOTOKEA.

Section A. **Asiphonacea.**

Family TELESTIDÆ.

Telesto rupicola Müller.
,, *arborea* Wright & Studer.

Family CŒLOGORGIIDÆ.

Cœlogorgia palmosa Wright & Studer.
,, *repens*, sp. n.

Family TELESTIDÆ.

TELESTO RUPICOLA Müller.

Under this species we have ranked three somewhat different specimens. The first consists of a single axial polyp 141 mm. in length, the lowest part of which is covered by a monaxonial sponge through which the lateral polyps protrude. The colour of the living specimen was yellowish with white zooids.

The axial polyp is 1·5 mm. in thickness near the point where it emerges from the surrounding sponge, but at the tip it is only 0·75 mm. The lateral polyps stand at regular intervals of about 6·5 mm. on all sides of the axial polyp; their height varies from 4–4·5 mm. and their basal diameter is 1·1 mm. In the lateral polyps the tentacles are 1·2 mm. in length and about 0·5 mm. in breadth, with numerous pinnules, which have an annulated appearance. On both sides of the base of each tentacle there are two bands of spicules which extend down the anthocodial part and join the spicules of the calyx. On the axial polyp and on the lateral polyps there are eight prominent ridges.

This specimen approaches *Telesto rupicola* of Hickson & Hiles, but there are some differences:—

(1) The tentacles of our specimen are longer.

(2) The arrangement of the lateral polyps is more regular.

(3) It does not very closely resemble Hickson's figure (Willey's Results, pl. l. fig. 1).

We note, however, the variability of *Telesto rupicola* as mentioned in Hickson's 'Alcyonaria of the Maldives,' pt. i. p. 482, and also in the 'Challenger' Reports, vol. xxxi. p. 262.

In the second specimen the axial polyp is 2 mm. in thickness, growing gradually less as it rises higher, and becoming 1·5 mm. near the tip. After treatment with caustic potash the hollow axis is seen to be composed of two types of spicules, some long and slender with few and slight projections, the others short and stout with numerous strong projections. The first type varies from 0·45–0·63 mm. in length and from 0·02 to 0·028 mm. in width; and the second from 0·15–0·2 mm. in length and from 0·02–0·028 mm. in width.

The third specimen differs slightly from both the others, but it also seems referable to *T. rupicola*.

Locality. Mr. Crossland notes: "By the kindness of Captain Agnew, R.N.R., I accompanied the steamer sent to overhaul the buoys and chains and found these specimens on the chains of the buoy nearest Zanzibar to the south."

TELESTO ARBOREA Wright & Studer.

One of the specimens is dark in colour and consists of a few axial polyps. From the axial polyps lateral polyps arise, and among these there are some decidedly larger than the others, which may be the beginnings of axial polyps of the second order.

The tentacles were measured in two specimens and were found to vary from 2·95–3 mm. in length. The surface spicules (0·5 × 0·05) are longer than the spicules of any of the other specimens. The axial polyps vary from 57–59 mm. in length and from 1·2–1·3 mm. in diameter. The average length of the lateral polyps is 4 mm.

The axial polyp treated with boiling caustic potash showed a firm compact tube marked by longitudinal ridges, and formed of two layers of spicules, an outer layer of stouter spicules, an inner of more slender forms.

Locality. Wasin, 10 fathoms.

In another specimen there is a rhizoid-like attachment. The primary axial polyp has been broken, but it is still 67 mm. in length. The complete secondary axial polyps are 95 mm. and 72 mm. in length. The lateral polyps are arranged irregularly on the axial polyps. On the lower part of the secondary axials they are 3 mm. by 3 mm., while on the upper part they are 2·6–3 mm. by 1·6 mm.

The axial polyp treated with boiling caustic potash shows a coherent tubular axis formed of two layers of spicules, an outer layer of stouter spicules with more prominent spines and an inner of longer, more slender spicules with few spines.

Locality. Wasin, 10 fathoms.

In another specimen the colour was light brown, the lateral polyps were about 3 mm. in length, and the longitudinal grooves were much less marked than in those above described. The spicules are transparent spindles with long, irregular, sometimes branching spines. The following measurements were taken of length and breadth in millims. :—0·12 × 0·04 ; 0·14 × 0·05 ; 0·18 × 0·05 ; 0·2 × 0·06.

Locality. Kokotoni Harbour, Zanzibar West, 5 fathoms; Wasin Channel, 10 fathoms. Previously recorded from Arafura Sea, 49 fathoms.

Family CŒLOGORGIIDÆ.

CŒLOGORGIA PALMOSA Wright & Studer.

A number of fragments which are evidently the portions of a large colony. In some of the larger fragments the axial polyp of the first (?) order attains a diameter of 5 mm.

The specimen agrees closely with the description given by Wright & Studer, except that in the tentacles, which are short and stumpy, there are four rows of pinnules on the oral surface, and in the outer row there are usually *ten* pinnules, not *eight* as stated in the 'Challenger' Report. The colour of the colony when preserved in spirit is a very pale green, but when dried it is almost white. The green colouring-matter is very soluble in spirit.

The present specimen also shows a greater degree of elasticity than that ascribed to the 'Challenger' specimen; when dried, however, it is very brittle and hard.

Locality. Station 12.

Previously recorded from Zanzibar (*Rousseau*); Nossi Bé in the Mozambique Channel, 10-12 fathoms (*Keller*).

CŒLOGORGIA REPENS, sp. n. (Plate XXXI. fig. 1.)

Several spreading colonies hardly exceeding 6 mm. in height. There are numerous polyps, in some groups of which it is impossible to distinguish the primary axial polyp from the others. The smallest polyps are mere papillæ 1·5 mm. in height, rising from a basal membrane; the longest project freely for 6–8 mm. An average breadth is about 1 mm. The surface is glistening white, and even to the naked eye appears rough and spicular. It is continuously covered with longitudinally disposed spindles.

On the upper part of the polyps there are eight longitudinal ridges ending in triangular points, which bend inwards to form a kind of operculum over the inturned tentacles. Each ridge is composed of a double row of spicules, and the components of each row overlap so that there may be three abreast at any one place. In the lower part of the polyp the grooves between the ridges are sometimes prominent and bordered by pairs of spicules from the two adjacent ridges meeting like the letter V with the point downwards. In other cases the lower part of the polyp seems to be uniformly covered.

The short and broad tentacles are completely inturned; they bear about 6–8 rows of short conical pinnules (13–16 in a row) covering the whole of the oral surface. On the aboral surface there are numerous minute spicules arranged in chevron. The spicules of the general surface are spindles with irregular spines and warts. The following measurements were taken of length and breadth in millims.:—0·75 × 0·08; 0·7 × 0·05; 0·4 × 0·04.

There can be but little doubt that these specimens represent young stages of colonies which have assumed an encrusting habit. They differ conspicuously from *C. palmosa* not only in the habit of growth, but in being rough and in having much larger spicules.

Locality. Wasin.

Section B. **Pennatulacea.**

Family VIRGULARIIDÆ.

Virgularia mirabilis Lamouroux, var. *pedunculata* Kölliker.
,, *multicalycina*, sp. n.

Family PENNATULIDÆ.

Subfamily PTEROEIDINÆ.

Pteroeides brachycaulon Kölliker.
,, *rigidum*, sp. n.
,, *pulchellum*, sp. n.

Family VIRGULARIIDÆ.

VIRGULARIA MIRABILIS Lamouroux, var. PEDUNCULATA Kölliker.

The rachis is 172 mm. in length, but the upper part (for 51 mm.) consists of nothing but the axis, which tapers to a fine thread. The axis is 0·42 mm. in diameter, brownish in colour, and marked by a large number of parallel transverse striæ. Towards the upper end of the unweathered part of the rachis the transparent pinnules are very closely packed together and smaller than those on the lower part of the rachis. They are separated from one another by intervals of 0·8 mm., and vary in breadth from 0·9–1·05 mm. and in height from 0·6–0·7 mm.

On each pinnule there are six or seven polyps in a single row. There is a clear streak on both rachidial surfaces of the rachis, but that on the prorachidial surface is slightly wider and has a groove running up the middle. The cœnenchyma is thin and transparent, allowing the axis to shine through on both surfaces.

Locality. Kokotoni, Zanzibar Island. In the mud at ordinary low-tide level. Previously recorded from Scandinavia, Denmark, Iceland, and Gulf of St. Lawrence.

VIRGULARIA MULTICALYCINA, sp. n. (Plate XXVI. figs. 4 & 5.)

A well-preserved portion of a colony, probably near the tip. It has a light brown colour, and was described when living as "black and light drab." In a length of 22 millims. there are on each side 11 pinnules, each about 2·25 mm. in height, and bearing about 66 polyps in 2–4 rows. The breadth of the vane is 8 mm., that of the axis 1·35. On the prorachidial surface there is a bare streak 2·5 mm. in breadth, with a median longitudinal groove. At the insertion of each pinnule there is a superficial ramification of the nutritive canal, forming a characteristic pattern. The metarachidial surface has also a bare streak, but this is entirely hidden by the interlocking of the pinnules, which form a quite continuous covering over the whole of that surface.

Very characteristic is the undulatory curvature of the margin of the pinnule; the ends of the insertion are on about the same level on the prorachidial and metarachidial surfaces. The calices are very distinct, barrel-shaped with narrowed mouths and longitudinal ridges. A polyp with expanded tentacles is 1·25 mm. in length, the calyx occupying about 0·9 mm.

On the prorachidial surface numerous minute zooids are to be seen, but no definite arrangement is recognisable. The shape of the axis is peculiar. The cross-section shows an irregular quadrilateral figure; the longest (metarachidial) side is 1·35 mm. in length and is slightly concave, the prorachidial side is 0·75 mm., and the two parachidial sides are slightly convex and about 0·75 mm. in length. On the surface of the axis there are longitudinally elongated elevations like interrupted ridges.

This species resembles *V. rumphii* Kölliker in the close-set pinnules, in the crowded polyps, in the branching of the nutritive canals, and in having a slightly flattened axis. It differs from it in having 66 polyps on a pinnule instead of 40–44, in having 2–4 rows of polyps instead of one row twisted so as to appear like two, and in having a different disposition of zooids.

Locality. Chuaka Bay, shore, lowest tide.

Family PENNATULIDÆ.

Subfamily PTEROEIDINÆ.

PTEROEIDES BRACHYCAULON Kölliker. (Plate XXVI. fig. 3.)

Belonging to this species there are several large specimens with a short rachis and a large spindle-shaped enlargement on the stalk.

	millims.
Length of pinnule-bearing portion	170
Breadth of pinnule-bearing portion	80
Length of stalk	50

On the rachis there is a broad bare space on the prorachidial surface; the corresponding part on the metarachidial aspect is hidden by the edges of the pinnules.

The colour is creamy with irregular patches and streaks of a purplish-blue.

The pinnules are 34 in number on each side, with two or three rudimentary forms at the lower end of the rachis. A well-developed pinnule has a breadth of 44 mm. and a height of 31 mm., and is supported by 16–18 rays.

The zooid-plate is median, leaving a crescent free from polyps at the basal insertion.

Locality. Kokotoni Harbour, West Coast of Zanzibar, 5 fathoms. Previously recorded from the Philippines.

PTEROEIDES RIGIDUM, sp. n. (Plate XXVI. figs. 1 & 2.)

Two specimens of a stiff colony very long in proportion to its breadth, apparently of a bluish-brown colour. As the zooid-plate is large and basal and the length of the rachis is at least eight times its breadth, the position of this species should be in Kolliker's group *Pt. argenteum*, but it does not agree with any of the forms there described.

The following measurements were taken from the stronger of the two specimens:—

	millims.
Total length of colony	230
Length of pinnule-bearing part	137
Length of stalk	93
Maximum breadth of pinnule-bearing part	17
Breadth of the middle of the stalk	8
Breadth of the swelling at the top of the stalk	10
Length of the swelling at the top of the stalk	15
Breadth of the pinnule halfway up	8
Height of the pinnule halfway up	5
Distance between pinnules	1·5–4·5
Breadth of the axis near the base	4

The stalk has a plump smooth appearance, but there are numerous small spicules in the cortical layer. The number of pinnules on each side is 46, but of these five on one side and seven on the other, situated at the top of the stalk, are rudimentary.

The metarachidial surface shows a bare streak 3–4 mm. in breadth, loosely overlapped by the pinnules in its middle region. There is no visible zooid streak, but the surface is not very well preserved. The prorachidial surface is smooth, and seems more deeply coloured than the rest; it varies in breadth from 3·5–10 mm. The rachis ends bluntly in a small bare area. In the other specimen the axis is exposed; it tapers rapidly to a fine point, and is soft and coiled for the last 14 mm.

The pinnules are somewhat reniform, with a narrow insertion. Thus, on one of the largest pinnules the insertion-line is only 4·5 mm. in length, but the outer margin is at least double. There seems to be some irregularity in the number of the supporting calcareous rays, but in some of the pinnules 4–6 are very distinct and project for about 1·5 mm. The specimen seems to have been somewhat battered, and no importance can be attached to the absence of rays in many of the pinnules.

The zooid-plate is basal and strongly developed. It extends in some about halfway up the pinnule; it is ridged and has an undulatory upper margin.

The polyps occur in three or four rows on each side of the margin of the pinnule, occupying a zone about 1·75 mm. in breadth.

The spicules of the cortical layer of the stalk consist of small rods and irregularly-branched forms. The following measurements in millims. were taken:—

Rods:—0·2 × 0·03.

Branched forms:—0·25 × 0·175; 0·3 × 0·175.

Locality. Wasin Channel, 8 fathoms.

PTEROEIDES PULCHELLUM, sp. n. (Plate XXVII. figs. 1 & 2.)

A beautiful finely-preserved colony, 37 mm. in total length and 13 mm. in breadth. The stalk is 16 mm. in length and 2·5 mm. in average breadth.

There are 15 (and 16) pinnules, of which 4 (and 5) at the base are very small. Each pinnule is supported by four rays of spicules, which may project about 2 mm. There are about 30 polyps arranged on the margin in a sinuous line, occasionally with young forms a little way down on either surface. The contracted polyps are barrel-shaped, with distinct longitudinal ridges, and the densely-crowded calices seem to differ much as to the depth of the indentation between them. A common height of calyx is 1 mm.; the expanded tentacles are 0·75 mm. in length and their tips enclose a circle about 1 mm. in diameter. There is a prominent oral cone and a circular mouth-aperture.

In some polyps the tentacles are pure white; in others they are backed by a chocolate-brown colour with a hint of blue. This colour is also seen in the calices and on the rachis, especially on its upper region.

The stalk is uncoloured and covered by irregular longitudinal ridges. There is evidence of a slight basal expansion, but this may be partly due to a contraction of the basal cœnenchyma, through which the end of the axis has been thrust. There is a slight swelling at the top of the stalk. The central axis (almost 1 mm. in diameter) tapers markedly for the last 4 millims., and ends in a twisted coil.

The metarachidial surface shows (1) an almost bare streak about 1·75 mm. in breadth, with a few (seven) zooids in a single row towards the upper end; (2) a deep median furrow which is evaginated as a ridge towards the base, doubtless a post-mortem result; (3) fine, close-set, longitudinal striations, about 12 on each side of the middle line; (4) scattered superficial spicules. The median zooids have a diameter of about 0·25 mm., and show no trace of tentacles.

The prorachidial surface has a bare space about 2 millims. in diameter; it shows a deep median groove, longitudinal striations less marked than on the other side, and a few irregularly-scattered spicules. The end of the prorachidial insertion of the pinnule is almost on a level with the metarachidial insertion.

The zooids occur on the inferior surface of the pinnules, and their insertion is what is termed median. Beginning with a cluster at the prorachidial insertion of the pinnule, they rise in a narrow crescent away from the base and descend gradually to the metarachidial insertion. They are white in colour and stand out like little octoradiate stars.

This species falls into Kölliker's second section with median zooid-plates and into the group *Pt. pellucidum*. It comes nearest *Pt. gracile*, but differs from it in many features, *e. g.* in having four main rays instead of 7–9, in having one row of marginal polyps instead of two, in having a very short zooid streak instead of a very long one (25 millims.).

Locality. Wasin Channel, 10 fathoms.

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EXPLANATION OF THE PLATES.

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5. *Virgularia multicalycina*, sp. n. Portion of prorachidial surface, with ramifying nutritive canals. × 12. p. 437.

PLATE XXVII.

Fig. 1. *Pteroeides pulchellum*, sp. n. A single pinnule, showing polyps, median zooid-plate, and four rays. × 8. p. 439.

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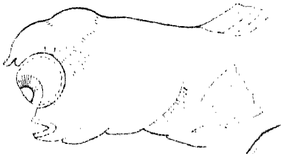

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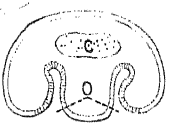

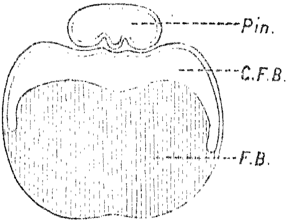

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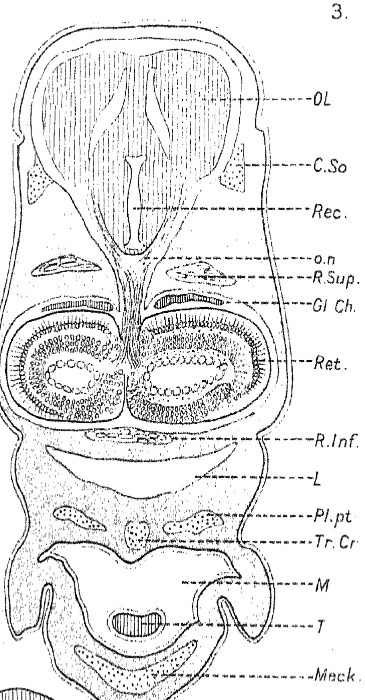

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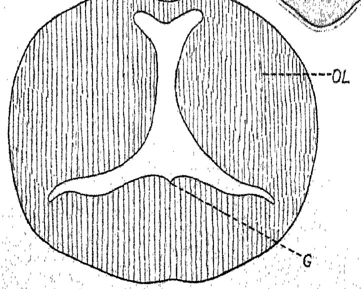

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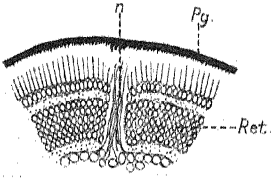

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CYCLOPIA IN OSSEOUS FISHES.

PLATE XXVIII.

Fig. 1. *Spongodes zanzibarensis*, sp. n. End of a branch. × 20. p. 424.
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PLATE XXXI.

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3. On Cyclopia in Osseous Fishes.

By JAMES F. GEMMILL, M.A., M.D.

[Received February 20, 1906.]

(Plate XXXII.*)

I. Description: p. 443.
II. Summary of Anatomical Details: p. 447.
III. Causation: p. 447.
IV. Comparison with Cyclopia in Mammals: p. 448.

I. DESCRIPTION.

Some time ago I obtained from the Lochwinnoch Trout hatchery four young Trout just escaped from their egg-membranes, which exhibited the condition of cyclopia.

As I could not find that the anatomy of this very interesting abnormality had previously been described in the case of any of the lower vertebrates, I examined the specimens carefully in the hope that some light might be thrown on cyclopia in the higher forms.

Classification.—The condition of the central nervous system may best be taken as the basis of classification, and my specimens belong to two types. The first is characterised by fusion, more or less complete, of the cerebral lobes (one specimen); the second by fusion of certain structures in the mid-brain as well as of the cerebral lobes.

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* For explanation of the Pate, see p. 449.

(A) *Cyclopia with Fusion of the Cerebral Lobes (one specimen).*

The external appearance of this specimen is illustrated by Pl. XXXII. fig. 1. The front of the head is wedge-shaped, its size being reduced in the transverse and increased in the vertical line. The large median eye is overarched by a mesial frontal process carrying a pair of small closely approximated olfactory pits (fig. 2). Upper and lower jaw arches are present. The posterior part of the head and the body are normal.

Cranial Skeleton.—The skeleton is greatly modified in front of the pituitary region. The *trabeculæ cranii* pass downwards so as to lie below the median eye (fig. 4). They are widely separated from the base of the brain and they take no part in the formation of an olfactory capsular cartilage. Anteriorly they articulate with short palato-quadrate bars. In the normal Trout embryo at a corresponding stage the trabeculæ, though united, still show evidence of their double origin. But in all my cyclopean specimens the trabeculæ form an absolutely single piece right back to the pituitary space.

A rudimentary olfactory capsule is derived from the united anterior ends of the supra-orbital bars. This united portion lies in the frontal process and is perforated by the two small olfactory nerves. Posteriorly the supra-orbital bars separate and pass along the dorso-lateral aspects of the brain to join the auditory cartilages, as in the normal condition. Near their place of separation each gives origin to an obliquus oculi superior muscle.

The mandibular, hyoid, and palato-quadrate bars are appreciably shortened in accordance with the small transverse measurement of the mouth.

Brain.—The cerebral lobes are slightly smaller than normal, and are in great part united along the inner faces. The longitudinal fissure penetrates for only a third of their depth in front at the place of origin of the olfactory nerves, while posteriorly close to the third ventricle the fissure in question appears simply as a shallow groove (fig. 3). The third ventricle and the optic lobe regions are well developed, pineal diverticula, optic recess, hypophysis, and hypoaria being present as in the normal condition. There is no dropsy of the central cavity of the brain or of the meninges. The cranial nerves are all present and are normal, with the exception of the first two pairs, the olfactories being small and closely approximated, while the optic tracts unite at the chiasma to form a single optic nerve.

Eye.—The globe is large and has its transverse diameter increased as also has the lens. The lens-cavity is not completely occupied by fibres, a space being left anteriorly which is filled by small round cells. Retina, choroid, cornea, vitreous humour, and sclerotic are well developed. The single choroidal fissure leads back to a large optic nerve formed, as above stated, by the union of the two optic tracts (fig. 4). There are two choroidal glands, one on either side of the optic pore. They are supplied, as usual, by choroidal arteries coming from the pseudobranchs. The following eye-muscles are present:—two superior obliques, arising from the supra-orbital bars; two superior recti, arising along with two inferior recti from the fibrous capsule of the brain in front of the hypophysis; two external recti, which are normal in origin and are inserted into the right and left sides respectively of the eyeball. The inferior recti are united close to their insertion into the eyeball. Inferior obliqui and internal recti are absent.

(B) *Cyclopia with Fusion of Structures in the Mid-brain and of the Cerebral Lobes.*

Three of my specimens exhibit this condition, two of them possessing a single median eye, while the third, although showing the other essential features of cyclopia, has a pair of small closely-approximated eyes.

1. The specimen which has a single eye resembles type A in general appearance, except as regards its mouth-parts. In place of the lower jaw there is a membranous flap on either side projecting downwards and forwards from below the eye. In place of the lower jaw arcade there is a narrow mesial process projecting forwards to end just between the flaps. Microscopic examination of the flaps shows that they contain externally a number of young teeth and internally a commencing membranous ossification. They are probably to be compared with ununited maxillary processes, and in this respect they resemble the horn-like structures found by Paolucci* in his cyclopean Skate.

The mesial process above mentioned contains a much elongated symphysis of the lower jaw, the Meckel's bars of which diverge little from one another and articulate with suspensoria which are similarly approximated.

Skeleton.—The trabeculæ cranii are represented by a single exceedingly short bar projecting downwards and forwards towards the wall of the pharynx. Quite separate from this are the palato-quadrates, the anterior ends of which, uniting below the eye, form a mesial plate replacing the defective trabeculæ. The supra-orbitals are different in the two specimens: in one they unite anteriorly in the frontal process, giving rise to a small olfactory capsule; in the other they are short and extend no further forward than the middle of the fore-brain. In this latter case

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* Atti della Societa Italiana di Scienze Naturali, vol. xvii. 1874.

The olfactory region is destitute of cartilage and there is no tegmen over the third ventricle. In both specimens the supra-orbitals are displaced downwards so as to be ventro-lateral to the brain. The auditory cartilages are displaced similarly but to a slighter degree.

Brain.—The cerebral lobes are markedly reduced in size and are fused together, the longitudinal fissure being almost entirely absent. The central cavity is slightly enlarged and extends downwards on the outer sides of the lobes further than in the normal condition. The pineal diverticula are small unstalked pouches. The optic lobes are of considerable size and are normal as regards their dorsal parts, but internally the mesial furrow of the central canal is only slightly marked (fig. 5) and there is absence alike of the optic recess, of the hypophysis, and of the hypoaria. Optic tracts and nerves are absent. As in type A, the olfactory nerves are small and closely approximated.

Eye.—The single small deeply embedded eyeball has no choroidal fissure, vitreous humour, or optic nerve. The lens and the retina are, however, fairly well developed and there are two choroidal glands. The position of the optic pore is marked inside the eyeball by an interruption of the retina exhibiting a few nerve-fibres, which, however, fail to pierce the hexagonal pigment-layer on the sclerotic (fig. 6). Two external and two superior rectus muscles are present. The other eye-muscles are wanting, with the exception of a pair of small superior obliques found in the specimen mentioned as having its supra-orbital bars extending forward into the frontal process.

Mouth.—The mouth-opening is represented by a minute canal, beginning at the bottom of the groove between the maxillary flaps and extending backwards above the symphysis of the lower jaw. In one case this canal ends blindly, in another it joins the pharynx.

2. The specimen which had two small eyes closely approximated but ununited shows the following characters:—cerebral lobes well developed, deeply cleft anteriorly, but united posteriorly; pineal diverticula small; third ventricle almost obliterated; fusion of structures in the floor of the optic lobes; rudimentary hypophysis and hypoaria; optic tracts and nerves absent; eyes small, embedded, almost touching one another, without choroidal fissure, vitreous humour, or optic nerve, but with well-developed lens, retina, and retinal pigment-layer; superior obliqui, superior and external rectus present for each eye, inferior recti and obliqui wanting; no mouth, the upper and lower jaws being sealed together; trabeculæ cranii extremely short, forming a single bar projecting downwards and forwards into wall of pharynx; olfactory capsules absent; supra-orbital bars ending separately in front, the tip of each giving origin to an obliquus oculi superior; olfactory pits approximated and supplied by small olfactory nerves.

II. SUMMARY OF CHIEF ANATOMICAL DETAILS.

Olfactory Organs.—Olfactory nerves and pits, reduced in size, are present in all my specimens. The olfactory pits lie close together on the inferior aspect of the mesial frontal process.

Brain.—Fusion of the posterior parts of the cerebral lobes is found in all my specimens. By itself, as in type A, this condition is compatible with the presence of a well-developed cyclopean eye possessing vitreous humour and an optic nerve, as well as with the presence of pineal diverticula, hypophysis, and hypoaria, and of optic tracts and optic recess.

Fusion of the basal structures in the mid-brain, as in type B, is associated with greater defects—viz., reduction in the size of the eyeball, absence of choroidal fissure, optic nerve and optic tracts, and absence or rudimentary condition of hypophysis and hypoaria.

Dropsy of the central cavity of the brain is conspicuous by its absence.

Eye.—As seen in type A, the eye may be remarkably well-developed, possessing lens, retina, vitreous humour, retinal pigment, and optic nerve. A double set of normal eye-muscles, excepting only the internal recti, may be present. Paired superior and external recti are constant, while the superior obliqui and the inferior recti are variable. The remarkable set of conditions which accompanies fusion of mid-brain structures has been mentioned above in connection with the brain.

Skeleton.—The trabeculæ cranii always appear as an absolutely single bar of cartilage underlying the median eye. Either they formed a single structure from the first, and this seems to me most probable, or their fusion was remarkably early and complete. Olfactory capsular cartilages may be present or absent; when present they are developed in connection with the anterior ends of the supra-orbital bars. The palato-quadrate, the mandibular and the hyoid bars tend to be shortened, in correspondence with the general transverse narrowing of the mouth-parts.

III. CAUSATION.

My specimens are not young enough to afford direct evidence regarding the mode of origin of the cyclopic condition. Probably pressure is the causal factor in most instances. It will be remembered that the egg-membrane of the Trout is tough and strong, and that the cavities of the optic bulb and stalk and even of the central nervous system are developed secondarily in solid masses of cells. It may be supposed that undue lateral pressure (from whatever cause arising, *e. g.* partial solidity or coagulation of the yolk) might bring the optic buds together, and cause them to unite *during their outgrowth.* If only moderate in degree, this pressure might by-and-by allow a central cavity to form in the now single optic bulb and stalk. Such a central cavity would permit the development of the secondary optic vesicle with its choroidal fissure. The choroidal fissure would enable mesenchymal cells to pass into the interior of the eyeball and form a vitreous body, and would enable also nerve-fibres growing from the retina to escape from the eyeball, pass along the optic stalk, and form an optic nerve and tracts such as are actually found in type A. The effect of moderate pressure on the brain may perhaps be recognised in the fusion of the posterior parts of the cerebral lobes characteristic of this same type.

A greater amount of lateral pressure might lead to such further degrees of fusion affecting the third ventricle and the mid-brain as are illustrated in type B. In the eye it might greatly hinder the formation of a central cavity in the primary optic vesicle and stalk. This condition might prevent the formation of a choroidal fissure by the usual method of ventral cupping. In the absence of a choroidal fissure, mesenchyma could not enter behind the lens to form a vitreous humour, and nerve-fibres formed in the retina would have no exit from eyeball to stalk, and the stalk itself would degenerate. The condition in type B might then be realised, *i. e.* an eye, reduced in size, with choroidal fissure, vitreous humour, or optic nerve.

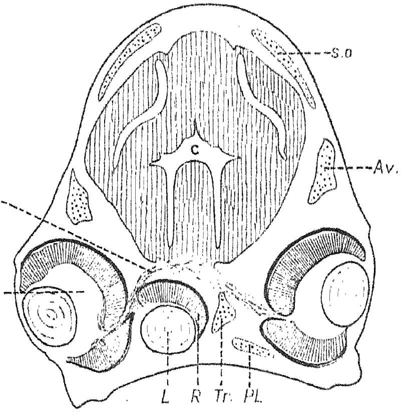
Analogous conditions, almost certainly due to pressure, are sometimes seen in double Trout monstrosities. One or both of the twin heads may show lateral compression, the eyes and the olfactory pits being approximated, the mouth narrowed, and the trabeculæ cranii ventrally displaced. In extreme cases the whole anterior part of the head may be atrophied, the mouth being deficient, the brain profoundly malformed, and eyes absent or represented only by a lens.

IV. Comparison with Cyclopia in Mammals.

1. While olfactory nerves do not seem to have been demonstrated in any mammalian cyclops, they are present in all my Trout specimens, being traceable from the cerebral lobes to the small olfactory pits on the under surface of the frontal process. If, as seems certain, this process represents the "proboscis" of a cyclopean mammal, the "proboscis" can have no relation with parts of the brain behind the cerebral lobes and in particular none with the hypophysis.

2. Dropsy of the central cavity of the brain is not characteristic of cyclopia in fishes. This may be contrasted with the usually saccular condition of the cerebral lobes in cyclopean mammals.

3. The relatively good development of all parts of the brain, particularly in type A, is remarkable. Indeed there seems to be no reason why a specimen of this kind should not be able to survive and obtain food for itself, as in the apparently unique case recorded by Paolucci.



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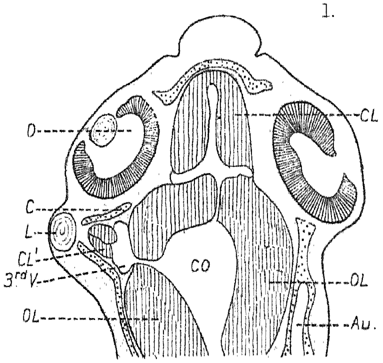

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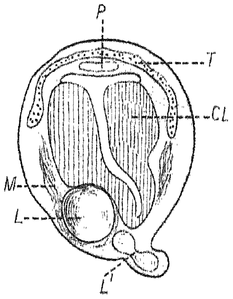

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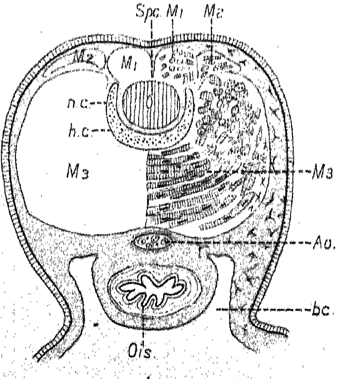

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SUPERNUMERARY EYES AND ABSENCE OF NOTOCHORD IN TROUT

EXPLANATION OF PLATE XXXI.

Fig. 1. Cyclopean Trout of type A, seen from left side.

Fig. 2. Transverse section through frontal process of the same cyclopean Trout, showing the small approximated olfactory pits (*O.*) and the reduced olfactory capsular cartilage (*C.*).

Fig. 3. Transverse section through posterior part of cerebral lobes of same, showing the cerebral lobes (*F.B.*) intimately united along their inner surfaces, and the pineal body *Pin.* The central cavity of the brain (*C.F.B.*) is not dropsical, and the cerebral lobes are almost normal in size.

Fig. 4. Section passing through mid-brain, posterior part of eye, and mouth of same:—

O.L.	Optic lobes.	*M.*	Mouth.
O.N.	„ nerve.	*T.*	Tongue.
Rec.	„ recess.	*C. So.*	Supra-orbital cartilages.
R. sup.	Rectus superior.	*Tr. Cr.*	Trabeculæ cranii.
R. inf.	„ inferior.	*Pl. qt.*	Palato-quadrate.
Gl. Ch.	Choroidal gland.	*Meck.*	Symphysis of lower jaw.
Ret.	Retina.	*L.*	Lymph space.

Fig. 5. Section through mid-brain of embryo belonging to type B, showing obliteration of the ventral groove which should pass down into the stalk of the infundibulum.

Fig. 6. Section through retina of eye described on page 446, showing failure of development of the optic nerve and of the choroidal fissure. *Pg.*, pigment layer; *Ret.*, retina; *f.*, a few fibres, which do not, however, pierce the sclerotic.

4. Notes on Supernumerary Eyes, and Local Deficiency and Reduplication of the Notochord in Trout Embryos. By James F. Gemmill, M.A., M.D.

[Received February 20, 1906.]

(Plate XXXIII.*)

(A) *Supernumerary Eyes in Trout Embyros* (*two specimens*).

The first specimen is in some respects unique in vertebrate teratology. My attention was directed to it by the presence of an interruption or cleft in the right upper jaw, producing the appearance of a right-sided harelip in what seemed to be, in other respects, a normal newly-hatched Trout embryo. On cutting serial sections, I found that a small additional eye lay at the bottom of this cleft, in the roof of the mouth, to the right side of the middle line, in the same transverse plane as the normal eyes. The additional eye is embedded in confused muscular tissue, has a well-developed lens, a small retina, no choroidal fissure and no choroidal gland. Its optic nerve is represented by a small bundle of fibres which sweep over the edge of the retina to join the right normal optic nerve (fig. 1, Pl. XXXIII.). The retina is small and elongated antero-posteriorly. The pigment-layer is present as such only in the posterior half of the retina. Anteriorly, the

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* For explanation of the Plate, see p. 452.

EXPLANATION OF PLATE XXXIII.

Fig. 1. Transverse section of head of Trout embryo with supernumerary eye.

L. Lens of supernumerary eye.
R. Retina " "
R.O. Right normal eye.
N. Right optic nerve receiving fibres from retina of supernumerary eye.
C. Central cavity of brain with two deep grooves in its floor, each of which leads downwards into an infundibulum and a hypophysis.
Tr. Trabeculæ cranii displaced towards left.
P.L. Palato-quadrate bar on left side; the right bar is absent.
S.o. Supra-orbital bar.
Au. Anterior corner of auditory capsular cartilage.

Fig. 2. Horizontal section of head of Trout embryo with supernumerary eye.

L. Lens belonging to the left (aborted) twin head.
CL'. Cerebral lobes belonging to ditto.
3rd V. 3rd ventricle belonging to ditto.
C. Cranial cartilages belonging to ditto.
O. Functional left eye.
CL. Functional cerebral lobes.
CO. Cavity of optic lobes.
OL. Optic lobes.
Au. Auditory cartilage.

Fig. 3. Transverse section of the atrophied single head described above.

L. The larger lens surrounded by muscle-fibres, *M.*
C.L. Cerebral lobes.
L'. The smaller hourglass-shaped lens.
P. Pineal body.
T. Tegminal cartilage.

Fig. 4. Transverse section through body of Trout embryo showing local deficiency of the notochord.

Sp.c. Spinal cord.
N.c. H.c. Neural and hæmal arch cartilages fused together.
M_1, M_2, M_3. Divisions of the muscle-masses.
Ao. Dorsal aorta.
Œs. Œsophagus.
Bc. Body-cavity.

5. On Three New Forms of Butterfly of the Genus *Heliconius*.

By Percy I. Lathy, F.Z.S., F.E.S.

[Received April 10, 1906.]

(Plate XXXIV.)

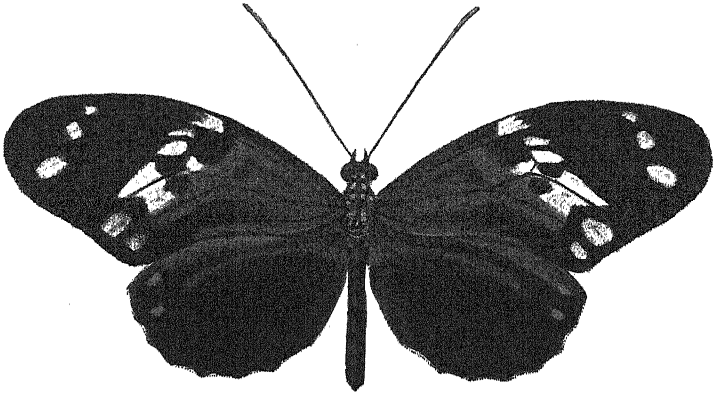
Heliconius pasithoë Cram., **fulvescens**, var. n. (Plate XXXIV. fig. 1.)

♀. *Upper side.* Fore wing black, with white markings as in typical *pasithoë* Cram., but the area between discal white markings and base chiefly fulvous. Hind wing black, with a long, narrow, fulvous fascia below subcostal nervure, two obscure whitish spots near apex.

Under side. Fore wing similar to upper side, but fulvous markings paler and discal white markings slightly tinged with yellow. Hind wing similar to typical *pasithoë* with exception of following fulvous markings: a streak along costa as above but slightly wider and paler, and a short, wide fascia from anal angle. Antennæ fulvous with basal half black.

Hab. Demerara. Coll. H. J. Adams.

One example of this remarkable form was obtained. I am



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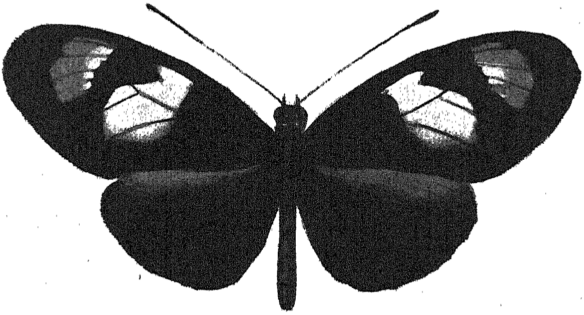

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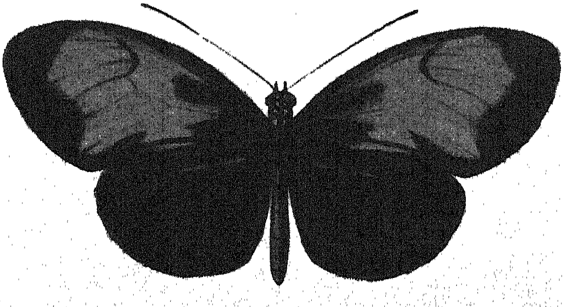

3.

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NEW FORMS OF HELICONIUS

inclined to think it may be a hybrid between *H. pasithoë* Cram. and *H. vetustus* Butl.

HELICONIUS XENOCLEA Hew., SUPERBA, var. n. (Plate XXXIV. fig. 2.)

♂. *Upper side.* Fore wing black, with large discal yellow patch edged with scarlet near anal angle, a subapical scarlet patch inwardly edged with yellow. Hind wing black, costal area widely greyish brown.

Under side. Fore wing blackish brown, with markings as on upper side but yellowish white and pale pink in colour; below submedian nervure shining greyish brown; a short scarlet streak at base of costa. Hind wing blackish brown, a yellow streak along basal half of costa; four basal scarlet spots, of which the upper two are minute.

Hab. Rio Colorado, Peru, 2500 ft. Coll. H. J. Adams.

This most beautiful specimen was captured by Messrs. Watkins and Tomlinson in September 1903, and is, I believe, unique.

HELICONIUS XENOCLEA Hew., CONFLUENS, var. n. (Plate XXXIV. fig. 3.)

♂. *Upper side.* Fore wing black, with the whole of the discal area scarlet. Hind wing black, with area above costa shining greyish brown.

Under side. Fore wing blackish brown, scarlet area restricted and replaced by pale pink; below submedian nervure shining greyish brown; a short scarlet streak at base of costa. Hind wing blackish brown, a yellow streak along basal half of costa, three scarlet spots at base, and an obscure dull red streak along upper part of cell.

♀. *Upper side.* Fore wing similar to male. Hind wing similar to male, but with faint scarlet streaks in and beyond cell and without shining greyish-brown costal area.

Under side. Fore wing similar to male, but pink area edged with pale red especially on lower margin, shining greyish-brown area absent. Hind wing similar to male. Ventral surface of abdomen greyish white in male, yellow in female.

Hab. Pichis Road, Peru, 3000 ft.; Rio Colorado, Peru, 2500 ft. Coll. H. J. Adams.

One example of each sex obtained; in typical *xenoclea* Hew. the patches are separated as in var. *superba*.

EXPLANATION OF PLATE XXXIV.

Fig. 1. *Heliconius pasithoë fulvescens*, var. n., p. 452.
2. „ *xenoclea superba*, var. n., p. 453.
3 „ „ *confluens*, var. n., p. 453.

P. Z. S. 1906, pp. 1–178,
were published on June 7th.

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THE END.

Printed by Taylor and Francis, Red Lion Court, Fleet Street.

No. 25.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

January 16th, 1906.

HOWARD SAUNDERS, Esq., Vice-President, in the Chair.

The SECRETARY read a report on the additions that had been made to the Society's Menagerie during the month of December 1905.

The SECRETARY also exhibited a series of photographs of the Red Deer illustrating the growth of the antlers, which had been presented to the Society by Mr. Walter Winans, F.Z.S.

Prof. E. A. MINCHIN, F.Z.S., exhibited a living specimen of a Lemur (*Galago*) which he had brought home with him from Entebbe, Uganda.

Dr. F. G. D. DREWITT, F.Z.S., exhibited, and made remarks upon, a white variety of the Common Mole.

Mr. OLDFIELD THOMAS, F.R.S., exhibited a skull of a Forest-Pig (*Hylochœrus*) sent by Mr. G. L. Bates from the Cameroons, thus confirming the report, already published, that *Hylochœrus* occurred near the West Coast. The species, however, appeared to be different from *H. meinertzhageni*, and was diagnosed as follows:—

HYLOCHŒRUS RIMATOR, sp. n.

General characters of skull as in *H. meinertzhageni*, but the teeth, and especially the last molars, conspicuously narrower and lighter, both above and below.

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* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

Basal length 325 mm.; last upper molar 42·3 × 17·5; last lower molar 48·2 × 16.

Hab. Ja River, Cameroons.

Type. Old female skull. Collected by Mr. G. L. Bates.

Mr. W. STORRS FOX, F.Z.S., read a paper on some bones of the Lynx (*Felix lynx*) found in a limestone cavern in Cales Dale, Derbyshire. This was only the third record of remains of this species having been met with in the British Islands.

Mr. J. L. BONHOTE, F.Z.S., communicated a paper dealing with a collection of Mammals recently collected in the Malay Peninsula by Mr. C. B. Kloss, and presented to the National Museum. The collection contained examples of 17 species, chiefly Rodents, of which two, representing well-known Bornean species, were described as new. There was also a series of *Mus jarak*, a species hitherto known from one specimen only and recently described by the author.

Mr. CHARLES S. TOMES, F.R.S., V.P.Z.S., read a paper on the minute structure of the teeth of the Creodonts. The author stated that suggestions which had been made as to a possible relationship between the Creodonts and the Polyprotodont Marsupials had rendered it interesting to see how far the structure of their teeth either supported or tended to disprove such speculations. Marsupial teeth possessed in the structure of their enamel a well-marked peculiarity, namely, the free penetration of the epiblastic enamel by tubes continuous with those of the mesoblastic dentine, and it happened that recent Carnivora, the descendants, more or less direct, of the Creodonts, also presented a disposition of the prisms of their enamel somewhat unusual amongst Mammalia. Teeth of *Hyænodon*, *Sinopa*, *Oxyæna*, *Pachyæna*, *Borhyæna*, *Didymictis*, and *Cynodictis* had been examined, and in none of them were marsupial characters observed; on the contrary, in most of them characteristic carnivorous patterns were found, so that in Oligocene and Eocene times their enamel had already attained to its full specialisations.

Mr. F. E. BEDDARD, F.R.S., read a paper entitled "Contributions to the Anatomy of the Ophidia."

Dr. JEAN ROUX, the Curator of the Basle Museum of Natural History, communicated a paper containing a synopsis of the Toads of the genus *Nectophryne*, with special remarks on some known species and description of a new species from German East Africa.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 6th February, 1906, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. E. S. RUSSELL.—On *Trichorhiza*, a new Hydroid Genus.

2. Dr. J. W. JENKINSON.—Notes on the Histology and Physiology of the Placenta in Ungulata.

3. Miss GERTRUDE RICARDO.—Description of a new Fly of the Family *Tabanidæ*.

4. Mr. HAROLD SCHWANN, F.Z.S.—A List of the Mammals obtained by Messrs. R. B. Woosnam and R. E. Dent in Bechuanaland.

The following Papers have been received:—

1. Mr. BASHFORD DEAN.—Notes on the Living Specimens of the Australian Lung-fish (*Ceratodus forsteri*) in the Zoological Society's Collection.

2. Mr. PERCY I. LATHY, F.Z.S.—On Three new Forms of Butterfly of the Genus *Heliconius*.

3. Mr. G. F. SPURRELL.—On the Angle of the Jaw.

4. Mr. GUY A. K. MARSHALL, F.Z.S.—A Monograph of the Coleoptera of the Genus *Sciobius*.

5. Mr. L. DONCASTER, F.Z.S., and the Rev. G. H. RAYNOR.—On Breeding Experiments with Lepidoptera.

6. Mr. W. P. PYCRAFT, F.Z.S.—Contributions to the Osteology of Birds.—Part VIII. The Tracheophone Passeres, with Remarks on Families allied thereto.

7. Mr. R. LYDEKKER.—On a Central-African Ratel and Water-Chevrotain.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 HANOVER SQUARE, LONDON, W.
23rd January, 1906.

No. 26.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

February 6th, 1906.

G. A. Boulenger, Esq., F.R.S., Vice-President,
in the Chair.

Mr. Frederick Gillett, F.Z.S., exhibited a case of mounted cubs of the Timber-Wolf (*Canis occidentalis*) which he had obtained in the Province of Keewatin, Canada. He remarked that this wolf was scarce in that district, being seen only occasionally in the winter and scarcely ever in the summer.

Dr. C. W. Andrews, F.Z.S., exhibited and made remarks upon some restored models of the skulls and mandibles of *Mœritherium* and *Palæomastodon*. The models were prepared by Mr. F. O. Barlow from the original specimens collected from the Upper and Middle Eocene beds of the Fayûm, Egypt, and now preserved in the British Museum and the Geological Museum, Cairo.

Dr. Walter Kidd, F.Z.S., exhibited lantern-slides of sections of skin from the palmar and plantar surfaces of twenty-four species of Mammals, and the plantar surfaces of seven species of Birds. The functions of the papillary ridges and the papillary layer of the corium in connection with the sense of touch were alluded to.

Dr. J. W. Jenkinson read a paper on the Histology and Physiology of the Placenta in the Ungulata, and made the following remarks:—

A recent examination of the histological structure of the placenta in the Sheep and Cow has shown:

(1) That in the formation of the accessory cotyledons of the Cow the epithelium lining the cotyledonary crypts arises by simple modification of the uterine epithelium.

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* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

(2) That in the fully formed principal cotyledons of both Cow and Sheep there is complete continuity of the intra- with the extra-cotyledonary uterine epithelium.

(3) That the greenish-brown pigment so abundantly present in the trophoblast-cells is a derivative of the hæmoglobin of the maternal corpuscles which those cells have ingested.

The pigment which contains no iron is of two kinds, one of which has a definite absorption-spectrum resembling closely that of oxyhæmoglobin. In acid solution the spectrum approaches that of acid hæmatoporphyrin.

Sir Edmund Loder, Bt., F.Z.S., exhibited a living specimen of a dwarf species of Cavy, probably the Salt-Marsh Cavy (*Dolichotis salinicola*), and remarked that, owing to Burmeister (the original describer of the animal) being under the erroneous impression that he had founded the species on young specimens and the fact that two distinct species occurred in the same district, some considerable confusion had been caused as to the status of the different forms of *Dolichotis*. He pointed out that the common Patagonian Cavy (*D. patagonicus*) differed from the dwarf *D. salinicola* and the larger *D. magellanicus centricola* (the two species found together) in having a broad dark band above the white rump-patch.

A communication from Mr. E. S. Russell contained a description of *Trichorhiza*, a new Hydroid genus, of which the diagnosis was as follows:—“Hydranth solitary, attached loosely by the hydrorhiza, which was filiform and branched. Invested by perisarc, which formed a protective cup into which the hydranth was partly retractile.” The genus had been founded for a single species, *T. brunnea*, the type specimen of which was discovered clinging to the tentacles of a *Corymorpha* dredged in the Clyde. Reproduction in *T. brunnea* was by medusæ. *Trichorhiza* belonged to the family *Pennaridæ*.

Miss Gertrude Ricardo communicated a description of the new genus *Melissomorpha*, formed for the reception of a Horse-fly of the *Pangoninæ* division of the family *Tabanidæ*, discovered by Col. C. T. Bingham in Sikkim. The insect closely mimicked the Indian bee *Apis dorsata* L., having the flattened wide tibiæ characteristic of the hive-bee, the general resemblance between the bee and the fly being very striking.

Mr. Harold Schwann, F.Z.S., read a paper on the Mammals collected at Kuruman and Molopo in Bechuanaland by Messrs. R. B. Woosnam and R. E. Dent. The specimens, numbering about 120 and belonging to 26 species, were of great interest as being topotypes of several species described by Sir Andrew Smith in his expedition to Kuruman and the interior of South Africa.

A communication from Mr. R. **Lydekker**, F.R.S., contained a description of a new species of Ratel (*Mellivora*) from Central Africa, also notice of the occurrence of a new subspecies of Chevrotain (*Dorcatherium*) in that district. The author proposed to divide the genus into three geographical races, viz. the typical form from the Gambia, Bates's Chevrotain from the Cameroons, and the present—Cotton's Chevrotain—from the Ituri Forest.

Mr. H. G. F. **Spurrell** read a paper entitled "The Articulation of the Vertebrate Jaw," and made the following remarks:—The object of this paper is to draw attention to the existence of two types of mouth in Vertebrates. In one type the articulation is in the plane in which the teeth meet; in the other type it is not in the plane in which the teeth meet, but in Mammals above, in Reptiles below that level. This alteration in level is attained in Mammals by an ascending ramus of the jaw, in Reptiles by a long quadrate bone. The first type is best seen in carnivorous Mammals. It allows of a wide gape and a successive play of the edges of the carnassial teeth from back to front as in the blades of scissors, and is incompatible with lateral movements of the jaw. The second type admits of comparatively slight separation of the teeth; it allows all the teeth to meet simultaneously; and in Mammals it allows of lateral movements of the jaw for triturating vegetable food. In the modifications of this type are considered the angle which the ramus forms with the dentary portion of the mandible, the eminentia articularis, and the prolongation forward of the jaws separating the incisor from the molar teeth. These are factors in obtaining the requisite movements of the jaw, especially a greater separation of the incisor teeth, than is required for the molars.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 20th February, 1906, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. L. **Doncaster**, F.Z.S., and the Rev. G. H. **Raynor**.—On Breeding Experiments with Lepidoptera.

2. Mr. W. P. **Pycraft**, F.Z.S.—Contributions to the Osteology of Birds.—Part VIII. The Tracheophone Passeres, with Remarks on Families allied thereto.

3. Messrs. **Oldfield Thomas**, F.R.S., and **Harold Schwann**, F.Z.S.—The Rudd Exploration of South Africa.—IV. List of Mammals obtained by Mr. Grant at Knysna.

4. Mr. **Bashford Dean**.—Notes on the Living Specimens of the Australian Lung-fish (*Ceratodus forsteri*) in the Zoological Society's Collection.

The following Papers have been received:—

1. Mr. Percy I. Lathy, F.Z.S.—On Three new Forms of Butterfly of the Genus *Heliconius*.

2. Mr. Guy A. K. Marshall, F.Z.S.—A Monograph of the Coleoptera of the Genus *Sciobius*.

3. Mr. C. Tate Regan, F.Z.S.—The Freshwater Fishes of the Island of Trinidad, based on Notes and Sketches made by Mr. Lechmere Guppy, jun.

4. Mr. G. A. Boulenger, F.R.S.—Fourth Contribution to the Ichthyology of Lake Tanganyika. Report on the Collection of Fishes made by Mr. W. A. Cunnington during the Third Tanganyika Expedition, 1904–05.

5. Dr. W. T. Calman, F.Z.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Macrurous Crustacea.

6. Mr. Edgar A. Smith, F.Z.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Mollusca.

7. Mr. R. Kirkpatrick, F.Z.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Porifera, with Notes on Species from the Nile and Zambesi.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
13*th February*, 1906.

No. 27.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

February 20th, 1906.

G. A. BOULENGER, Esq., F.R.S., Vice-President, in the Chair.

The SECRETARY read a Report on the additions that had been made to the Menagerie during the month of January 1906, and called special attention to a Snow-Leopard (*Felis uncia*) presented by Major A. H. Hussey, R.H.A., an Aard Wolf (*Proteles cristatus*), purchased, and a Salt-Marsh Cavy (*Dolichotis salinicola*), received on deposit.

The SECRETARY also read a letter from Maj.-Gen. Sir Reginald Talbot, K.C.B., Governor of Victoria, giving an account of the supposed breeding of a mule. An illustration of the dam and foal from 'The Australasian' accompanied the letter.

Mr. R. I. POCOCK, the Superintendent of the Gardens, exhibited a photograph of a Ring-tailed Lemur (*Lemur catta*) carrying its young on its back.

Dr. A. SMITH WOODWARD, F.R.S., F.Z.S., exhibited a new drawing of the skeleton of the Triassic Rhynchocephalian, *Rhynchosaurus articeps*, from the Keuper Sandstone of Shropshire. He pointed out the differences between this ancient reptile and the modern *Sphenodon*, especially noting the great expansion of its coracoids and ischia, and the probably diminutive size of its sternum. He inferred from the everted rims of the upwardly-turned orbits, and from the sigmoidal bend of the femur, that *Rhynchosaurus* was to a great degree aquatic in habit.

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Mr. L. Doncaster, M.A., F.Z.S., and the Rev. G. H. Raynor, M.A., communicated a paper on Breeding Experiments they had made with Lepidoptera.

The species used were *Angerona prunaria* and its var. *sordiata*, and *Abraxas grossulariata* and its var. *lacticolor*.

In *A. prunaria* the banding of the var. *sordiata* was dominant over its absence in the type, but the speckling characteristic of the type appeared in the heterozygote, so that the latter was both banded and speckled. The characters appeared to segregate in the typical Mendelian manner, but in several families there was an excess of *prunaria* over *sordiata*. In *A. grossulariata* the var. *lacticolor* was a Mendelian recessive, but was normally found only in the female. By pairing a heterozygous male with a *lacticolor* female, *lacticolor* males and females were obtained. *Lacticolor* male × female gave only *lacticolor*; *lacticolor* males by heterozygote females had given all males of the type, all females *lacticolor*.

Several typical families of each species were exhibited.

Mr. W. P. Pycraft, F.Z.S., read a paper on the "Tracheophone Passeres," which he described as a group differing from all the remaining Passeres in the formation of the syrinx, which was tracheal—instead of tracheo-bronchial—and peculiar among syringes of the tracheal type in the development of a cartilaginous pillar for the insertion of the intrinsic muscles. The group was divisible into three sections: (*a*) having holorhinal nares and a single-notched sternum, (*b*) with schizorhinal nares and a single-notched sternum, and (*c*) with holorhinal nares and a doubly-notched sternum.

He proposed to make the Tracheophone Passeres one of four great divisions of the Passerine stem. The most primitive of the divisions would contain the Eurylæmidæ, Cotingidæ, and *Philepitta*. The second would be represented by the Tracheophonæ, the third by the Tyrannidæ and Pittidæ, and the fourth by the rest of the Passeres.

A paper by Messrs. Oldfield Thomas, F.R.S., and Harold Schwann, F.Z.S., was read, giving an account of a collection of Mammals made by Mr. C. H. B. Grant at Knysna, and presented to the National Museum by Mr. C. D. Rudd. The collection consisted of about 150 specimens, belonging to 31 species or subspecies, of which the most noticeable was Mrs. Rudd's Golden Mole (*Amblysomus corriæ*), the description of which had already been laid before the Society.

A new generic name, *Nototragus*, was applied to the Grysbok, which differed from the other members of *Raphicerus* by its possession of supplementary hoofs.

A communication from Prof. Bashford Dean contained an account of the habits of the Australian Lung-fish (*Ceratodus forsteri*) as observed by him in the Society's Menagerie.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 6th March, 1906, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. G. A. BOULENGER, F.R.S.—Fourth Contribution to the Ichthyology of Lake Tanganyika. Report on the Collection of Fishes made by Mr. W. A. Cunnington during the Third Tanganyika Expedition, 1904–05.

2. Dr. W. T. CALMAN, F.Z.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Macrurous Crustacea.

3. Mr. EDGAR A. SMITH, F.Z.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Mollusca.

4. Mr. R. KIRKPATRICK, F.Z.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Porifera, with Notes on Species from the Nile and Zambesi.

5. Mr. F. E. BEDDARD, F.R.S.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the Oligochæta.

The following Papers have been received:—

1. Mr. PERCY I. LATHY, F.Z.S.—On Three new Forms of Butterfly of the Genus *Heliconius*.

2. Mr. GUY A. K. MARSHALL, F.Z.S.—A Monograph of the Coleoptera of the Genus *Sciobius*.

3. Mr. C. TATE REGAN, F.Z.S.—The Freshwater Fishes of the Island of Trinidad, based on the Collection, and Notes and Sketches, made by Mr. Lechmere Guppy, jun.

4. Prof. J. ARTHUR THOMSON and Mr. W. D. HENDERSON.—The Marine Fauna of Zanzibar and British East Africa from Collections made by Cyril Crossland in the Years 1901–02. Alcyonaria.

5. Dr. J. F. GEMMILL.—Cyclopia in Osseous Fishes.

6. Dr. J. F. GEMMILL.—Notes on Supernumerary Eyes, Local Deficiency and Reduplication of the Notochord in Trout Embryos.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary.*

3 HANOVER SQUARE, LONDON, W.
27th February, 1906.

No. 28.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

March 6th, 1906.

CHARLES S. TOMES, Esq., F.R.S., Vice-President, in the Chair.

Mr. G. A. BOULENGER, F.R.S., V.P.Z.S., exhibited a specimen of *Rana goliath*, obtained by Mr. G. L. Bates at Efulen in South Cameroon. This frog measured 10 inches from snout to vent and was much larger than any frog hitherto known.

Mr. R. SHELFORD, M.A., C.M.Z.S., read a note on "flying" snakes, and made the following remarks:—The power of "flying" has been recorded by natives to be possessed by three species of snakes in Borneo, viz. *Chrysopelea ornata*, *C. chrysochlora* (Opisthoglypha), and *Dendrophis pictus* (Aglypha). All three species have the ventral scales with a suture or hinge-line on each side; by means of a muscular contraction these scales can be drawn inwards, so that the whole ventral surface of the snake becomes quite concave and the snake itself may be compared to a rod of bamboo bisected longitudinally. By experiments on *C. ornata* it was seen that the snake when falling from a height descended not in writhing coils, but with the body held stiff and rigid, and that the line of the fall was at an angle to a straight line from the point of departure to the ground. It is highly probable that the concave ventral surface of the snake helps to buoy it up in its fall; it can readily be shown that a longitudinally bisected rod of bamboo falls more slowly than an undivided rod of equal weight.

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A series of Reports on the Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington in 1904–05, was read.

The Report on the Fishes was by Mr. G. A. Boulenger, F.R.S., who stated that the collection consisted of 300 specimens referable to 84 species, 28 of which were new.

Of Crustacea, reported upon by Dr. W. T. Calman, in addition to the two species already known from Lake Tanganyika, no fewer than ten specimens of new species belonging to the family Atyidæ, including the representatives of two new genera, were obtained. From Lakes Nyasa and Victoria Nyanza only a single species was got, the widely-distributed *Caridina nilotica* (*C. wyckii*). The absence of this common species from the gatherings made in Tanganyika emphasised the isolated character of the Macruran fauna of that lake. All the species found in Tanganyika and all but one of the genera were peculiar to the lake. There was no ground for regarding the Macrura of Tanganyika as having any specially "marine" affinities. The other members of the groups to which they belonged, the genus *Palæmon* and the family Atyidæ, were characteristically and all but exclusively fresh-water animals.

The collection of Mollusca, reported upon by Mr. Edgar A. Smith, I.S.O., contained examples of 33 species, one of which was new.

Mr. R. Kirkpatrick reported on the Freshwater Sponges obtained from Lakes Victoria Nyanza, Tanganyika, and Nyasa. The collection comprised eleven specimens representing five species, one from Tanganyika being new to science, two others from Tanganyika (*Spongilla moorei* Evans and *S. tanganyikæ* Evans) having already been recorded from that locality. Small specimens of a fourth species, viz. *Spongilla carteri* Bowerbank, were obtained from the Victoria Nyanza, and a fairly large specimen of a fifth, viz. *Spongilla biseriata* Weltner, was collected in a swamp bordering Lake Nyasa.

Included in Mr. Kirkpatrick's report were descriptions of two new species and a new variety of Freshwater Sponges, based on material obtained from the White Nile.

The Oligochæte Worms were reported upon by Mr. F. E. Beddard, F.R.S. They comprised examples of four new species.

Mr. R. T. Günther exhibited and made remarks on the Medusæ of the genus *Limnocnida* obtained during the Expedition.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 20th March, 1906, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mr. G. A. K. MARSHALL, F.Z.S.—A Monograph of the Coleoptera of the Genus *Sciobius*.

2. Dr. HANS GADOW, F.R.S.—A Contribution to the Study of Evolution based upon the Mexican Species of *Cnemidophorus*.

3. Mr. PERCY I. LATHY, F.Z.S.—On Three new Forms of Butterfly of the Genus *Heliconius*.

The following Papers have been received:—

1. Mr. C. TATE REGAN, F.Z.S.—The Freshwater Fishes of the Island of Trinidad, based on the Collection, and Notes and Sketches, made by Mr. Lechmere Guppy, jun.

2. Prof. J. ARTHUR THOMSON and Mr. W. D. HENDERSON.—The Marine Fauna of Zanzibar and British East Africa from Collections made by Cyril Crossland in the Years 1901–2. Alcyonaria.

3. Dr. J. F. GEMMILL.—Cyclopia in Osseous Fishes.

4. Dr. J. F. GEMMILL.—Notes on Supernumerary Eyes, Local Deficiency and Reduplication of the Notochord in Trout Embryos.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 HANOVER SQUARE, LONDON, W.
13th March, 1906.

No. 29.

ABSTRACT OF THE PROCEEDINGS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.*

March 20th, 1906.

Dr. Henry Woodward, F.R.S., Vice-President,
in the Chair.

The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of February 1906.

The Secretary exhibited a paper cutting representing the print of the fore foot of a large wild Indian Elephant, which had been taken from an impression left in the soil, by Mr. C. A. Sherring, Deputy Commissioner at Almora, India. The circumference of the print was 66 inches.

The Secretary also exhibited, on behalf of Mr. John Bowes, F.Z.S., a tooth of the Mammoth from the sand in the estuary of the East Swale, about three miles west of Herne Bay.

Mr. Oldfield Thomas, F.R.S., F.Z.S., exhibited a Brown Bear from the Shan States, which appeared to represent a new form of the *A. arctos* group. It was diagnosed as follows:—

URSUS ARCTOS SHANORUM, subsp. n.

Most nearly allied to *U. a. yesoensis* Lyd., but smaller and with much shorter, broader teeth.

Basal length of skull 295 mm.; last upper premolar 17 × 15.

Hab. Shan States.

Type. Male. B.M. No. 6.3.16.1. Received in exchange from the Calcutta Museum, to whom it had been presented by the late Mr. Rutledge.

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Mr. R. E. **Holding** exhibited, and made some remarks on, specimens illustrating anomalies and variations in the teeth of animals.

Dr. **Walter Kidd**, F.Z.S., exhibited, and made remarks upon, a second series of lantern-slides of sections of the skin from the palmar and plantar surfaces of Mammals.

Dr. C. G. **Seligmann**, the Society's Pathologist, read a paper which contained, in tabulated form, the causes of deaths that had occurred amongst the mammals and birds in the Menagerie during the year 1905.

A communication from Mr. **Guy A. K. Marshall**, F.Z.S., contained descriptions of the species of the Coleopterous genus *Sciobius*. The genus comprised 41 species, of which 22 were described as new by Mr. Marshall.

Dr. **Hans Gadow**, F.R.S., F.Z.S., read a paper entitled "A Contribution to the Study of Evolution based upon the Mexican Species of *Cnemidophorus*." The main object of the paper was to trace the correlation of certain variations exhibited by the lizards of this genus, and the environmental, bionomic conditions. To do this a revision of the numerous species of the genus had been necessary, most of the ample material for which had been collected by the author himself. Especial attention had to be paid to an exhaustive study of the surprisingly great variability of certain characters, in particular the changes of the colour-pattern and the scutellation of the collar and of the limbs. The distribution of the many races, into which some of the species seemed to have recently differentiated themselves, was likewise followed up in detail.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 10th April, 1906, at half-past Eight o'clock P.M., when the following communications will be made:

1. Mr. C. **Tate Regan**, F.Z.S.—The Freshwater Fishes of the Island of Trinidad, based on the Collection, and Notes and Sketches, made by Mr. Lechmere Guppy, jun.

2. Prof. J. **Arthur Thomson** and Mr. W. D. **Henderson**.—The Marine Fauna of Zanzibar and British East Africa from Collections made by Cyril Crossland in the Years 1901–2. Alcyonaria.

3. Dr. J. F. **Gemmill**.—Cyclopia in Osseous Fishes.

4. Dr. J. F. **Gemmill**.—Notes on Supernumerary Eyes, Local Deficiency and Reduplication of the Notochord in Trout Embryos.

The following Papers have been received:—

1. Mr. Oldfield Thomas, F.R.S.—On Mammals collected in South-west Australia for Mr. W. E. Balston.

2. Mr. F. E. Beddard, F.R.S.—Contributions to the Knowledge of the Vascular and Respiratory Systems in the Ophidia, and to the Anatomy of the Genera *Boa* and *Corallus*.

3. Mr. J. N. Halbert.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the *Hydrachnidæ*.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
27th March, 1906.

No. 30.

ABSTRACT OF THE PROCEEDINGS
OF THE
ZOOLOGICAL SOCIETY OF LONDON.*

April 10th, 1906.

Herbert Druce, Esq., F.L.S., Vice-President, in the Chair.

Mr. F. E. Beddard, F.R.S., exhibited a partially dissected specimen of the Scincoid Lizard, *Trachysaurus rugosus*, to show the existence in that species of abdominal ribs.

Mr. R. I. Pocock, F.Z.S., exhibited the skull of a Horse showing pre-orbital pits.

Mr. C. Tate Regan, B.A., F.Z.S., read a paper dealing with the Freshwater Fishes of the Island of Trinidad, chiefly based on a collection made by Mr. Lechmere Guppy, Jun., and presented by him to the British Museum. The collection was accompanied by natural history notes and by a series of beautifully executed water-colour drawings. Forty species of Freshwater Fishes were now known from the island; these were enumerated in the paper and four of them described as new to science.

The Secretary read a communication from Prof. J. Arthur Thomson and Mr. W. D. Henderson, which contained an account of the collection of Alcyonarians made by Mr. Cyril Crossland at Zanzibar in 1901-02. Specimens of sixty-five species or varieties were contained in the collection, of which twenty-seven were described as new.

A paper from Dr. J. F. Gemmill treated of Cyclopia in Osseous Fishes, as observed by him in several advanced Trout embryos. A detailed account of the anatomy of the specimens was given and a comparison made with Cyclopia in Mammals. The author's views were also put forward regarding the mode of origin of this condition in Fishes.

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A second paper by Dr. Gemmill contained descriptions of cases of supernumerary eyes, and local deficiency and reduplication of the notochord, in Trout embryos.

A communication from Mr. Percy I. Lathy, F.Z.S., contained descriptions of three new varieties of Butterflies of the genus *Heliconius*.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 1st May, 1906, at half past Eight o'clock p.m., when the following communications will be made:—

1. The Hon. Walter Rothschild, M.P., F.Z.S.—Additional Notes on Anthropoid Apes, with exhibition of specimens.

2. Mr. Oldfield Thomas, F.R.S., F.Z.S.—On Mammals collected in South-west Australia by Mr. W. E. Balston.

3. Mr. H. J. Elwes, F.R.S., F.Z.S., and Sir George Hampson, Bt., F.Z.S.—On the Lepidoptera collected during the recent Expedition to Tibet.

The following Papers have been received :— (44)

1. Mr. F. E. Beddard, F.R.S.—Contributions to the Knowledge of the Vascular and Respiratory Systems in the Ophidia, and to the Anatomy of the Genera *Boa* and *Corallus*.

2. Mr. J. N. Halbert.—Zoological Results of the Third Tanganyika Expedition conducted by Mr. W. A. Cunnington, 1904–05. Report on the *Hydrachnidæ*.

3. Mr. Oldfield Thomas, F.R.S.—On Mammals from Northern Australia presented to the National Museum by Sir William Ingram and the Hon. John Forrest.

4. Prof. W. B. Benham, D.Sc., and Mr. W. J. Dunbar.—On the Skull of a young Specimen of the Ribbon Fish (*Regalecus*).

5. Mr. Alwin K. Haagner, F.Z.S.—A List of the Mammals of Modderfontein, Transvaal, with Notes on their Habits.

Communications intended for the Scientific Meetings of the Zoological Society of London should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 Hanover Square, London, W.
17th April, 1906.

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